THE UNIVERSITY
OF ILLINOIS
LIBRARY

621.05
P
V.6

This book has been DIGITIZED
and is available ONLINE.

CENTRAL CIRCULATION BOOKSTACKS

The person charging this material is responsible for its renewal or its return to the library from which it was borrowed on or before the **Latest Date** stamped below. **You may be charged a minimum fee of $75.00 for each lost book.**

Theft, mutilation, and underlining of books are reasons for disciplinary action and may result in dismissal from the University.

TO RENEW CALL TELEPHONE CENTER, 333-8400

UNIVERSITY OF ILLINOIS LIBRARY AT URBANA-CHAMPAIGN

AUG 25 1997

When renewing by phone, write new due date below previous due date. L162

Popular Mechanics

Index to Vol. VI.

1904

January to December Inclusive

Popular Mechanics Company
Chicago.

A

Accident on the Pennsylvania..... 531
Acetylene Headlight for Operating at Night, Surgeon's 1234
Adirondack Forest Fires Largely the Work of Incendiaries 1018
Aerial Craft, French, Has Some Strange New Features 1205
Aerial Races, New Rules for..... 542
Airship Contests at St. Louis..... 1206
Airship Factory Builds Queer Craft..... 227
Airship, Illinoisan Building an..... 656
Airship Race, The Great..... 1013
Airship Successful, Californian's..... 1001
Airships New Kind of Propellers on..... 732
"Alabama's" Splendid Gun Record..... 2111
Alaska Needs a National Wagon Road..... 718
Aluminum Used for Letters and Figures.... 616
American-Built Ship Delights Sultan..... 713
Americans Use Too Much Water..... 359
Amusement Device, The Meteor Auto..... 1211
Amusement Feats, Limit of Daring..... 534
Antitoxin Trust 210
Apple Crop This Year, Big..... 904
Arizona Ranges, Goats on..... 1231
Armored Battleship, Is Day of Ending?... 601
Auto, Around the World in an..... 154
Auto, Carried on Boat..... 340
Auto Comes Over from France, Powerful... 226
Auto Flying-Machines, French Inventors Working at 958
Auto for Infants 1102
Auto Propels a Fire Engine..... 912
Auto Replaces Mule 1130
Auto Saved the Bank..... 905
Auto Telegraph Car 1035
Autos, Electric Puncture Preventer for..... 557
Autos, Side-Slip Preventer for..... 639
Autoboats Becoming Popular..... 637
Autoboat Race, Across Ocean, $10,000 for.. Winner of 1217
Automobile Ambulance for Injured Dogs and Cats 740
Automobile at High Speed..... 933
Automobile 'Bus Line, Porto Rican..... 742
Automobile Contest, Goal Among the Clouds 920
Automobile, Conveniently Built..... 507
Automobile Cup Race, France Wins in..... 806
Automobile Draws Street Car..... 1110
Automobile First 334
Automobile, First in United States..... 1232
Automobile for Emperor of China..... 934
Automobile Hospital 823
Automobile in England, War..... 654
Automobile in France, Gearless..... 1016
Automobile, Largest in World..... 701
Automobile Light, English..... 340
Automobile, Plowed with an..... 1133
Automobile Police Patrol for City Work.... 932
Automobile, Rides to Fires in..... 547
Automobile School for Horses..... 1231
Automobiles, Five Hundred Dollars Popular Price for 1110
Automobile Street Sprinkler 833
Automobiles That Run on Railroad Tracks. 1016
Automobile Tour to St. Louis..... 709
Automobile Train 222
Automobile, Trimming Arc Lamps by..... 1138

B

Back Yard of City House, How to Beautify 445
Balloon for Sailing Twenty Miles Above Earth 206
Balloon, French Test Naval..... 1126
Balloon, Photographed Peaks of Alps from.. 1205
"Baltic," Largest Vessel Ever Built..... 913
Baltimore Fire, Lessons Taught by..... 322
Banana Expresses 730
Bananas Unloaded by Electricity..... 547
Bank Vault Opened by Electricity..... 1224
Banquet in a Sewer..... 108
Bath Hoist for Invalid..... 361
Battleship Launched, America's Largest.... 533
Battleships, United States, Under Construction 1214
Bicycle Handle Buffers, Anti-Vibrating..... 364
Bicycle Race, Stationary..... 908
Bicycle Tires, How to Keep from Creeping. 1133
Billiard and Bowling Balls, Rubber..... 336
Blacksmith Shop for Use in Battle, Wheeled 223
Blizzard in the West, Battling..... 121
Block Systems, Railroads Using..... 356
Boat Planned, Fifty-Miles-an-Hour..... 640
Boilers for Lake Boats, Big..... 539
Boulevard 1,500 Miles Long, to Build a..... 546
Brakes to Stop Ships..... 941
Brass, to Polish..... 455
Brick Building, Raised 180 Feet..... 540
Brickyard, Cost of Starting a Small..... 236
Bridge at St. Paul Wrecked..... 1031
Bridge Building in the Philippines..... 1210
Bridge, Chain Suspension 128
Broken Legs Can Walk..... 931
Brush, Metal, for Car Washing..... 1102
Bucket, Folding 717
Bucket Tramway in Mountains of Washington 1225
Buildings of America, Great—
New York Skyscraper..... 237
First National Bank Building, Chicago.. 332
Railway Exchange of Chicago..... 443
National Bank of Commerce, St. Louis.. 525
Bulkhead Doors in Unsinkable Ships..... 362
Bullet-Proof Garments, Russian Soldiers Will Wear 1053
Burial Mounds of Northern Michigan, Relics from 718
Butter Glazed to Keep It Fresh..... 1108

C

Cable, Great Salt Lake Spanned by Aerial.. 912
Caisson Disease, "Bends" or..... 1227
Camera, Naturalist's 331
Camera Tripod, Home-Made..... 1119
Camps, Permanent, How to Build..... 848
Camps, Temporary, How to Build..... 750
Cannon, Double-Barreled, John Gilleland's.. 126
Canopy, A Mortuary..... 1004
Car Ferry Burns, Ice-Bound..... 624
Cars, Double-Decker, for Twin Cities..... 654
Cars for New York Subway, Steel..... 711
Cars, High Speed Requires Single..... 1230
Car, Scale Testing 634
Cars Switched by Gravity..... 609
Cement, A Good Pipe..... 336
"Cesarovitch," Russia's Monster Battleship. 161
Chair Made in One Piece..... 832
Charcoal Burning in New England..... 257
Cheese, How Made 923
Chess Game, Novel..... 1155
Chicago's Water Waste Is 4,000,000,000 Gallons Annually 1029
Church Boon to Seamen, Floating..... 1015
Church Moved Long Distance..... 711
Circular Saw, Largest..... 110
Clock, Coaster 1131
Clock, Handless 724
Clock, Ten-Hour 1028
Clothes, How to Render Fire-Proof..... 454
Coal Dock Operated by Electricity..... 234
Coal Mining Depth Has a Limit..... 957
Coal, Ton of, Does Work of 40,000 Men..... 331
Cofferdams of I-Beams..... 1014
Cold Storage Plant on Rails..... 1022
Color Photography, Patent for..... 531
Columns, Largest America Ever Saw..... 220
Compressed Air, Cleaning Streets With..... 825
Compressed Air, Cutting Trees and Logs by 546
Compressed Air, Cutting Trees With..... 243
Compressed Air, Treasure of Old Spanish Galleons to Be Raised by..... 1213
Conduits for Water Power, Huge..... 131
Contact, Shielded Flexible for Use in Car Houses 637
Controller on a Trolley Car..... 1038
Convenience for Housewives..... 752
Convention Hall, Greatest in America..... 119
Converters, Passing of Old Type Bessemer. 231
Copper Vessels, How to Cleanse..... 733
Corn Cob Meal, How Made..... 1111
Corn Crib, How to Build a Rat-Proof..... 1053
Corn Crib, Portable 157
Cotton Boll Weevil..... 442
Cotton Crop, Gathering the..... 1121
Cotton Famine, England Suffers from..... 1033
Cotton Growing, Africa Ideal for..... 929
Cotton Growing, England Encourages..... 1231
Crane, Portable Pneumatic Jib..... 832
Crane, Self-Propelling 826

621.05
P
v. 6

Crane, Wrecking, Lifts Trains from Niagara River 125
Cruiser "Hampshire," New English..... 118
Cruiser, Turkey Has New..... 131
Cultivator, Three Hundred Miles on a..... 932
Cut Glass, How Made..... 801

D

Dam, Highest in the World..... 741
Deadly Fourth 724
Dead Sea's Only Boat 558
Debt to John Hay, America's..... 320
Decoy Duck That Flies..... 340
Desert Traffic, New Scheme of..... 922
Desk for a Child..... 1230
Diver's Life Is Full of Perils..... 610
Dock for Baltic Fleet, Portable Floating... 1211
Dock Takes 8,600-Mile Voyage, Floating.... 703
Donkey Wheel, English 524
Don't Lose Your Head..... 902
Door Opener, Automatic 118
Doves of Peace Are Messengers of War.... 906
Dredger Lifts Over Thousand Tons an Hour, English 901
Dredges, New Government Suction..... 557
Dredge, The Whistle of (Poem)..... 156
Duns Set to Music..... 240
Dyeing Machinery, Improvement for..... 820
Dynamite Bombs Manufacturing 244

E

Echoes in Church Building, To Prevent.... 114
Education for Every American Almost Free 157
Egg Preserving Machine 128
Eiffel Tower Coming Down..... 230
Electrical Draftsmen, Conventional Signs Used by Foreign..... 1132
Electrical Experiments, Easy—
Ammeter for Electro Platers..... 116
Simple Electric Lamp Outfit..... 256
Duplex Telegraph Instrument..... 338
Thermo Electric Generator 444
Simple Electric Engine..... 532
Electric Canal Haulage 128
Electric "Canal Mule" 437
Electric "Canal Mule" Has Come..... 357
Electric Display at a San Francisco Event. 1125
Electric Double Whirl..... 1018
Electric Ears for Ships..... 213
Electric Ears Reach Far..... 238
Electric Feeders to German Railways..... 357
Electric Lamp Decorations, Danger in..... 904
Electric Lights for Lighthouses..... 830
Electric Locomotives for a New York Line. 836
Electric Night Sights 1126
Electric Power in the Tropics..... 123
Electric Shock, Greatest on Record..... 358
Electric Shock, Russian Rules for Help in.. 424
Electricity, American Coasts Protected by.. 1121
Electricity Extrudes the Bootblack..... 211
Electricity for Nothing 237
Electricity for Steam Roads..... 1125
Electricity vs. the Steam Engine 235
Electricity—What Is It?..... 632
Electrography: A Companion to Photography 1251
Electrolysis in St. Paul, To Remedy..... 1037
Elevator Fire Escape and Standpipe..... 423
Embalming Weird Method of..... 215
Embossing Machine, Ingenious..... 1128
Emery Wheel Speed, Limit in..... 226
Emperor William 935
Endurance Run in Truth Was This..... 242
Engine, Biggest Ever Exhibited at Any World's Fair 1003
Engine, Largest in India..... 633
Engine, Perfectly Equipped Inspection..... 856
Engines, Powerful Marine 928
Engine "999" Now Hauls a Milk Train..... 828
England Plays the Game of Nations..... 201
Excavator that Digs Canals, Giant..... 321
Explosions, Device Prevents Oil or Gasoline 942

F

Fair, Going to in Rowboats..... 707
Farming Becomes a Mechanical Operation.. 924
Fell 800 Feet and Survived..... 918
Ferris Wheel Moved to St. Louis..... 755
Fire Arms, Era of New and Powerful.... 312
Fire Boats, New York Has Two New $180,000 755
Fire Engine, George Washington's..... 1020
Fire Engines in the Air..... 939
Fire Engines on Exhibit, Powerful English 930
Fire Engine Operated by Compressed Air.. 137
Fire Engine Provides Music for School Exercises 929
Fire Extinguisher, Wonderful..... 539
Fire Hose, Drying by Electricity..... 1109
Fire Hose to Fit Any Hydrant..... 1008
Fire Ladder, Novel Winding..... 335
Firemen to Qualify as Engineers..... 1039
Fire Photograph, Remarkable..... 455
Fish Ladders for Minnesota Dams..... 1032
Fish Trains of England..... 136
Flax, Fuel from 539
Flying-Machine, The Truth About..... 1201
Football Armor, Latest..... 1224
Forests Are the Nation's Life..... 159
Forge, Brick, How to Make..... 547
Forge, First Lessons at the—
Part I—Tools and Materials..... 657
Part II—Bending, Swaging and Welding.. 738
Part III—Bending, Swaging and Welding (Useful Articles) 853
"Four Admirals" of the Tropics..... 233
Freight Train Wrecked Bridge Span..... 922
French Navy, New Pride of..... 438
Fuel Alcohol for America..... 558
Fuel Briquettes, German..... 119
Fuel, Liquid, Pumped to Battleship While in Motion 1217
Fuel Oil for Naval Use..... 833
Fuel, Smokeless 539
Furniture, Learn to Make Your Own..... 614
Furniture, Vibrating 957

G

Gardens One Hundred Feet Under City..... 125
Gas Distribution, High Pressure..... 334
Gas Engine on the Farm..... 1233
Gasoline Locomotive, Largest Ever Built.. 614
"General Slocum" Disaster..... 807
Germany's Newest Achievement..... 235
Gold Dredge Digs Wealth from Sands..... 229
Government Printing Office Wakes Up..... 455
Grain Bin, Portable..... 908
Gramaphone Records for Wimshurst Machine 118
Grapes, Harvesting in America's Vineyards. 1129
Ground Detector, Three-Phase Static..... 1128
Gunboats Shipped Long Distance..... 856
Gun May Shoot 100 Miles..... 615
Gun Throws Line Long Distance..... 826
Gutta-Percha, Artificial 1106

H

Hand Ten Feet Long..... 121
Hatch Every Egg, Makes Hen..... 541
Hat-Makers Getting Busy, Tropical..... 311
Hats, Rain-proof 1032
Heat of Steel, Instrument Shows the..... 108
Hectograph Sheets, How to Make..... 1054
"Hello" Universal Wherever Telephone is Used 110
He Needed It Later..... 241
Hitching Three Horses to a Wagon..... 537
Hoisting Machinery, Some Remarkable..... 1103
Hole Twelve Miles Deep—Stupendous Project of British Scientists..... 1124
Horizon, Prism for Measuring Dip of..... 135
Horn, Collapsible 508
Horses Rode, When..... 458
Hose Couplings at Rochester, Misfit..... 514
Hospital Town 1007
Hospital Train at Mukden, In the Russian 933
Hospital Train, Finest Ever Built..... 831
Hotel Boats for the Mississippi..... 640
House-Boat Trip from Chicago to St. Louis.. 1040
House that Follows the Sun..... 221
Hydraulic Lift Lock, Trent Canal..... 1005

I

Ice Crusher, Russia Copies American..... 341
Ice Crushers, Russia's King of..... 409
Ice Factory, Jerusalem Has Its First..... 359
Icicles at Niagara Weighing Hundreds of Tons 421

432336

Incubator at the Fair, Baby..... 820
Incubator Hatches 300 Chickens Daily..... 407
Ink for Writing on Glass..... 834
Inventors, Women as..... 162
Iron, Smelting by Electricity..... 126
Iron Vessel, An Early Built..... 156
Iroquois Curtain Exonerated..... 457
Iroquois Disaster..... 207
Irrigation Canal Through Tunnels..... 543

J

Jails in Which Convicts are Caged at Night, Portable..... 1017
Japanese at Last Our Friends..... 422
Japanese Badges Denote Vocations..... 718
Japanese Imitate Foreign Machines..... 710
Japanese Mines the Terror of Russian Fleets 1036
Japs Draw the Line at Mackintoshes..... 924
Japs—The Modern Spartans..... 725

K

Knife Worth $5,000..... 536

L

Lassa, the Forbidden City, Entered..... 325
Lathe Attachments—
Part I—Description of Division Plate and Pointer..... 218
Part II—Overhead Gear..... 354
Part III—Milling Attachment for Rotary Cutters..... 453
Part IV—Milling and Drilling Spindle..... 535
Part V—Gear Wheels and Rotary Cutters 638
Launch, Gasoline, Largest in World..... 855
Lens, Largest in the World..... 827
Letters and Parcels by Wire, May Dispatch 440
Lifeboat, New Type of..... 921
Lifeboats, English Improvement in..... 128
Life-Saving Globe May Supplant Lifeboats for Ship Use..... 840
Life Suit, Probst's..... 1053
Light at Port Antonio, Jamaica..... 363
Lighthouse, Tall Beton and Steel, Erected by Russian Government..... 1229
Light, To Secure Without Matches..... 1109
Linemen, Elephant Aids..... 834
Liner, Largest American-Built..... 541
Lipton Again in the Race..... 1019
Liquid Fuel for Roumanian Steamers..... 244
Locomotive and Train, Proposed Road..... 1153
Locomotive Attains High Speed, New German..... 1052
Locomotive Car, Combination..... 1226
Locomotive, Electric vs. Steam..... 1226
Locomotive Fire Engine, New York Central's 719
Locomotive for Saxony, Freight..... 324
Locomotive Has Engineer's Cab in Front, Italian..... 655
Locomotive Hauled Itself 300 Miles by Water 1056
Locomotive, Heaviest and Most Powerful Ever Built..... 1212
Locomotive, New Mammoth Freight..... 932
Locomotive, Road..... 1210
Locomotive, Russian Passenger..... 142
Locomotives, Baldwin Builds Six a Day.... 1113
Locomotives for Interurban Service, Gasoline 823
Locomotives, Steam, to Burn Electricity.... 346
Locomotives, Steel Tubes for..... 142
Locomotives, Work of Depends on Their Firemen..... 1002
Logging in the Jungles..... 225
Log, Travels to the World's Fair in..... 919
Lucin Cut-Off, Golden Spike Completes..... 132
Lunch Counter Car a Great Hit..... 1021

M

Machine Shop Without Shafts or Belts..... 130
Machinist Must Be a Specialist..... 238
Magazine Pistol, Instrument of Death..... 112
Mail, Brings to the Door..... 717
Mail in Thibet, "Overland"..... 1209
Marconi System, Progress of..... 1127
Matches, Why Do They Break?..... 236
Maté, the Latest Drink for Soda Fountains 548
Meal Scoop, Automatic..... 1136
Mechanical Features of the War..... 809
Mechanical Figures Almost Human..... 1011
Metal Resembles Silver..... 639
Military Experiment Cost $500,000..... 1008
Milk, How to Pasteurize..... 1055
Milk, Machine for Drying..... 934
Mill, Another North Carolina..... 136
Mills on the Danube, Current..... 334
Mine, Diving in a..... 1111
Miners, Safety Device for..... 1020
Mining, Using Explosives in..... 155
"Missouri," Lesson of..... 617
Monitor "Wyoming," United States..... 857
Mormons, Early Homes of..... 412
Mosquito Destroying Apparatus, Electrical.. 819
Motor Boat Racing, Great Interest in..... 224
Motor Boats Race Across English Channel. 1027
Motor 'Bus to Compete with Street Cars... 708
Motor, Capillary..... 1130
Motor Car, Boy Builds..... 129
Motor Cars for Suburban Service, Test..... 1156
Motor Cycling a Coming Fad..... 109
Motor, Detachable Cycle..... 1156
Motormen, Spring Heels for..... 534
Motor Omnibuses, Carry Mail in..... 826
Motor Train Transportation of Troops..... 957
Motor Transfer Service..... 1008
Mountain Peak, America's Highest..... 239
Mushrooms Grown in Caves, French..... 958
Musician, What He Sees..... 123

N

Naval Gun Practice, One Million a Year for 537
Navies, Demonstration of World's in 1900.. 702
Negatives, How to Mark Titles on..... 1124
News Put in Type While Happening..... 829
Nodium is Lighter than Aluminum..... 656
North Pole, Steam Vessel to Crush Way to 628
North Pole, to Roll to..... 721
Noses of Wax, Making..... 343

O

Oiled Clothing, How to Make..... 930
Oiled Roads in California..... 852
Oil Mine, A Scottish..... 544
Oil, Pits for Storing..... 542
Oil Production the Past Year..... 1226
Oil Tank, 150-Ton Steel, Moved Down the Allegheny..... 713
Old Way and the New..... 364
Organ, World's Largest Completed..... 742
Ostrich Farm, United States..... 751
Overhead Ferry at Nantes, France..... 360

P

Panama Canal, Preparatory Work on..... 1023
Panama Canal, Sanitation Along Route to Be Enforced..... 717
Panama, Costs Money to Land in..... 921
Panama, Standard Silver Dollars for..... 840
Pancake Leather..... 364
Passenger Train After Collision..... 905
Passengers by the Pound, Haul..... 328
Patent Laws, New Mexican..... 162
Peat, Converted into Coal by Electricity.... 232
Peat, Fuel of the Future..... 625
Peanut Oil, Its Manufacture and Uses..... 917
Petroleum Makes Cloth Waterproof..... 428
Phonograph, New Triumph for..... 708
Phosphorus, To Alloy with..... 123
Photographer Abandons Sunlight..... 558
Photographers, A Suggestion for..... 820
Photographic Contrasts, Some..... 1054
Photographing Fish from Life..... 458
Photograph, Largest in the World..... 260
Photographone—An Electric Stenographer.. 543
Photographs, How to Print on Glass or China..... 833
Photographs the Interior of the Human Eye, Instrument..... 1218
Photo Negatives, How to Write On..... 640
Plush Car Seats in Kentucky, No..... 1030
Pole Line, Grading a..... 141
Poles, Manufactures..... 1016
Politeness Pays..... 1020
"Porcupine," New Machine for Repairing Macadam Roads..... 1122
Portland Cement, to Distinguish from Slag. 363
Postage, Australians Pay into Slot Machines..... 1053
Postal Camera Clubs the Fad..... 346
Postcards, a Good Method of Printing..... 936
Postoffice in Italy, Traveling..... 828
Pounding the Solid Choke..... 1030

Powder, Dangers of Smokeless..... 335
Prints, Reversed, How to Make Direct from.. Negative 1054
Propellers for British Vessels, Outturning.. 917
Pulse Controller for Operations..... 428
"Pushball on Horseback," a New English Game 852

R

Race, Ocean, $10,000 for Winner of..... 1217
Race, 3,000-Mile Ocean 222
Radium, Future of 439
Radium, Metal of Mystery..... 101
Rail, A Renewable 212
Railroads of the World 921
Railroad to Mohammed's Shrine..... 437
Railway Appliances, Copy American..... 221
Railway from Winnipeg to Hudson Bay.... 525
Railway Motor Service in Germany..... 929
Railway Project, History's Greatest..... 456
Railway Run of 245¾ Miles Made Daily Without Stop..... 1017
Railway Track, Highest Speed..... 141
Railway Tracks of Early Days..... 153
Railway Underneath Chicago, Freight..... 309
Rate War Between Atlantic Steamship Lines 808
Rides Rough Seas in Comfort..... 940
Rifles of Russia and Japan..... 720
Rockefeller to Pipe Oil Across America..... 501
Rubber and Its Substitutes..... 134
Rubber, Price of, Advancing..... 1138
Rugs, Electric Heated..... 1102
Rural Letter Carrier of Egypt..... 408
Russia's Herculean Task in the Far East... 413

S

SHOP NOTES. (See page 6).....

Safety-Lamp Device, British..... 435
Sahara, If It Were a Sea..... 156
Sailing Ship, British Iron Shipentine "California" 1111
Sailing Vessels, Self-Pumping Device for... 224
Sailors Ordered to Black Their Faces..... 1102
Salt, Americans Use Plenty of 1135
Salt, How Produced in Ohio..... 911
Santos Dumont Has Two Rivals..... 113
Satan, Outwitting 1032
Savings Bank That Cannot Fail..... 624
Scales, Largest Ever Built..... 954
Scenes from the Great Conflict..... 914
Scrap Lead Roofs 829
Screens Focusing 1254
Searchlight for Launches 756
Seed Tester, A Simple Home-Made..... 1133
Ship Dug Up in Ireland..... 158
Ship, How the Admiral Controls..... 512
Ship Speed and Action, Forecasting..... 1215
Shoot Straight, Teach Soldiers to..... 254
"Short Time to Make a Meeting Point"..... 255
Shovel, The Man Behind the..... 1123
Show Windows, Frost on..... 142
Silk in America, Weaving..... 158
Silk Worms Made to Dye Cloth..... 361
Silo, Construction and Use of..... 953
Simplon Tunnel, Work on..... 235
Skyscrapers, Fears Collapse of Boston's.... 423
Skyscrapers, Fire-Proof, Stood the Test.... 323
Slocum Horror, Ascribes to American Greed 931
Small Boy versus the Horse..... 360
Smoke Helmets for Firemen..... 640
Smoke House, How to Build..... 356
Smoke Respirators for Firemen..... 941
Snare Drum, How to Tighten Up..... 1052
Snow Sheds on Wheels..... 411
Soda Water, Americans Drink 910,000,000 Glasses of 1033
Southerner Uplifts the Negro..... 734
Space Telegraph Stations, Armies Will Use 909
Split Wood, Machine to..... 456
Sports, Newest of Thrilling Kind..... 633
Stage Illustion, Mysterious Mechanical..... 821
Steamer Lengthened 72 Feet..... 653
Steamer, Sawed Lengthwise..... 342
Steamer "Vanderbilt" 536
Steamship Eight Stories High..... 1010
Steamship, Largest Fresh-Water in the World 734
Stenographers, Mechanical 1010
Stern Wheel of the Sprague, Enormous.... 111
St. Louis World's Fair, Transportation at.. 735
Stone-Cutting Machine, Portable..... 805
Street Car Crossing Signal..... 432
Street Cars as Quarters for Consumptives.. 709
Street Cars, Pure Air and No Drafts for... 1056
Street Paving Problem..... 1034
Street Railways in the United States..... 737
Street Sprinkler and Sweeper, Steam..... 115
Submarine Automobile Boat, America's..... 301
Submarine Boat A 1, Tragedy of..... 509
Submarine Boat, Disaster Befalls Russia's Finest 818
Submarine Boats for Japan, American-Built 1218
Submarine Boat Wins in Endurance Test... 839
Submarine Coal Mines in Japan..... 714
Submarines, Danger Signals for..... 512
Submarine, Future of 629
Sub-Station, Portable 439
Sugar Factories on Irrigated Land..... 243
Sun's Corona, Weighed 1020
Suspension Bridge, Budapest, Great Elizabeth 818

T

Target Practice in the German Army, Realistic 1055
Technical High School, Largest in World... 545
Technical World 546
Telegraphy Necessitates Brain, Modern..... 752
Telephone Adjunct, Writing by Wire..... 719
Telephone Convention, Interstate Independent 122
Telephone Engineering an Inviting Field for Young Men 712
Telephone, How to Send Music by..... 155
Telephone in Paris, Antiquated..... 362
Telephone in the White House..... 1127
Telephone Line, How to Build by Using a Wire Fence 925
Telephone, News Bureau Run by..... 918
Telephone Poles, How Set 1107
Telephone Reports Results of Shots..... 742
Telephone, Rural Produce Exchange Conducted by 733
Telephones at Street Corners..... 710
Telephones, Card Display Device for..... 1110
Telephone Scouts, Armies Have..... 822
Telephone, Seeing by Wire..... 1137
Telephones, Writing Pad for Desk..... 215
Telescope, Largest in the World..... 1008
Telpherage—Aerial Transportation 1219
Temples, Tearing Down Egypt's..... 241
Thermometer Tubes, How Made..... 542
Third Rails, Thawing..... 1108
Third Rail, Westinghouse Condemns..... 930
Tibet, The Invasion of..... 731
Tide Mill, Curious 545
Tigers, How the Chinese Catch..... 937
Time Signals—Flash New Year's Greetings Round the Globe 137
Toll Messages, How They Are Timed..... 1134
Torpedo Boat Destroyers, U. S. S. Lawrence 824
Torpedo Flotilla, Long Voyage of..... 631
Torpedoes, Machine to Place on Railroad Track 356
Torpedo—War's Deadliest Weapon..... 401
Tower Crane, Electric..... 406
Towpath, No More..... 922
Track Highway, Steel 637
Traction Engine Draws a Long Train of Wagons 835
Traction Engine Harvests Crop and Plows Ground at Same Time..... 540
Traction Engine Travels in the Air..... 1019
Traction Engine Won War Prize, English.. 538
Train Carries Court House Bodily from One Town to Another 441
Training Ship for American Jackies, The "Cumberland" 1209
Trains Buried in February Snow..... 337
Train, Victoria's Longest..... 1101
Transport "Grant" Converted into a Dredge 161
Trans-Siberian Railroad 513
Trees, Big, Urge Government to Save..... 235
Trees Having Hollow Trunks, Preserving... 829
Triplex Block, Enables One to Lift Tons... 429
Trolley Causes Appendicitis..... 629
Trolley Fire Engine Car..... 548
Trolley Line to Run Through the Capitol Building at Washington 903

Trolley Sleeper Has Come..... 216
Troops by Trolley 935
Trucks That Climb Hills, Freight..... 424
Tunnel, Santa Susana, Finished..... 902
Tunnels for Pipes in Streets..... 361
Tunnel, Sinking Rock for..... 423
Turbine, Age of, Has Come..... 129
Turbine Liner "Victorian"..... 1119
Turbine, Noted Authority Declares Against 835
Turbines Used 2,700 Years Ago..... 219
Turquoise in Europe, American..... 911
Typewritten Music 832

U

Under-Water Terrors of Modern Warfare... 517

V

Vaults, Underground 1051
Vehicle, Native of Japan..... 637
"Vibrochord," Machine for Feeling Music.. 333

W

Wagon, Invents a One-Wheeled..... 240
Wall Papering, How to Do Your Own..... 425
"War Airship" to Destroy Russian Fleet.. 530
War, Commentaries on Far Eastern..... 215
Warps in the Loom, Sizing of..... 221
Warring Nations Meet on Neutral Ground, Where 1029
Warships, Speed in 1036
Warships to Carry Models of Themselves... 443
War Vessels on the Lakes..... 432
Washing by the Pound..... 421
Washing Prints, Home-Made Machine for... 154
Washing the Lies Out of a Japanese Boy... 920
Water Balks the British, Bad..... 420
Water, Carrying in Mexico..... 107
"Water Curtain," a Perfect Theatre Protection 508
Water, How Mexicans Prospect for..... 1028
Water Main Used in New York City 107 Years Ago, Piece of..... 1232
Water Pipes, Thawing by Electricity..... 454
Water Problem Is Solved, St. Louis..... 619
Water System, Philadelphia High Pressure. 651
Water Wheel Problem..... 244
Water Wheels, World's Two Greatest..... 329
Water Works Run by Alcohol Motor..... 1031
Weather Forecasting to Be Made Perfect... 206
Weeds on Ship's Bottoms, Killing with Electricity 1013
Wells, Oklahoma Perforated with Deep.... 710
Whaling Industry, America May Be Excluded from 821
Wharf, Longest, in the United States..... 942
Wheat, Best Flour from Mixed..... 1230
Wheat in Demand, Kansas..... 1155
Wheel, Emergency for Autos..... 1156
Why the American Boy Does Not Go to Sea 829
Why They Don't Win (Poem)..... 157
Windmill Automobile 1009
Wine Tank, Society Dances in..... 127
Wireless Telegraphy—Daily Papers Printed in Mid-Ocean 756
Wireless Telegraphy for 1904..... 436
Wireless Telegraphy, France to Test..... 230
Wireless Telegraphy, Government Tries New System 1022
Wireless Telegraphy on Board Ship..... 834
Wireless Telegraphy Station Completed, Largest 1054
Wireless Telegraphy Stations, U. S. Government to Control 755
Wireless Telegraphy Tower, Latest..... 828
Wire Rope Made by the Romans 1,800 Years Ago 1214
Wood Alcohol, Use of Followed by Blindness and Death 659

X

X-Rays, Some Facts About..... 523

Y

Yachting Festival, Brilliant Scenes at an English 1037
Yachting Rules, Lipton Scores American.... 314

SHOP NOTES.

Acetylene, Device to Prevent Explosions of 452
Acid Cup and Dip..... 249
Air Compressor, Improvised..... 1139
Air Compressor, Oiling Cylinder of..... 246
Alloy, How to Make a Useful Soft..... 1045
Aluminum, The Welding of..... 552
Ammonia Fumes, Antidote for..... 648
Anti-Hum Device, English..... 347
Anvil and Straight Edge, Combination..... 746
Arc Light, How to Make an..... 549
Armatures, Rapid Method of Testing..... 246
Automobiles, Emergency Rope Tire for..... 1245
Automobile Tires, Filling 952
Axle, How to Repair Broken..... 1141
Babbitt Metal, Isaac Babbitt Did Not Invent 1140
Bag-Holder, Handy, Home-Made..... 1041
Band Saw, How to Fold a..... 1145
Bathtub, How Moved by One Man..... 1041
Batteries in Series..... 449
Bayberry Wax, Use of in Pattern Making.. 1048
Bearings, Copper Wire for Hot..... 450
Bellows, Evolution of the..... 446
Belt Clamp, Handy..... 556
Belt, Half Twisting a Quarter Twist..... 147
Belt Fits, Keep Them Dry..... 152
Belts, Leather 143
Bit, Home-Made 347
Blacksmith and Power-Driven Machinery... 1147
Blowpipe Metal Welding..... 551
Blueprint Paper for Blue Lines on White Paper 352
Blueprints, Correcting 554
Blueprints, Radical Change in..... 347
Blueprints, Valuable Method of Preserving. 648
Boats, Gasoline Faster Than Steam..... 247
Bobsleds, Improvement in 452
Boiler Going into Disuse..... 1139
Boiler Tubes, Cleaning 1248
Boilers, Caulking 943
Boilers, Old Range, What to Do With..... 251
Boilers, Steam Dome on, Unnecesary..... 844
Brass Furnace, How to Build an Emergency 245
Brass, Hints on Melting..... 646
Brass, Melting with Oil Flame..... 551
Brush, Miller's, To Clean Corners..... 247
Brass, Plaster as a Flux for..... 946
Brass, To Clean Chased..... 643
Burns from Hot Water or Steam, Treatment of 556
Burns, Remedy for 745
Burns, Remedy for Vitriol..... 555
Cable, Operating Transfer Car by..... 147
Calipers, Handy Inside..... 945
Camphor, Predict Weather with..... 645
Canvas Top, How to Paint a..... 944
Cars, Freight, Ordered in 1903..... 251
Casting, Bronze, To Prevent from Adhering 842
Castings, Cleaning Gray Iron..... 842
Castings, How to Weigh Irregular..... 1144
Castings, To Pickle Brass..... 646
Cast Iron, How to Soften..... 150
Cast Iron, How to Unite..... 643
Cast Iron, Tinning..... 643
Cast Iron, To Drill Chilled..... 643
Celluloid, To Make Non-Inflammable..... 648
Cement, How to Use in Cold Weather..... 647
Cement Leather to Iron..... 551
Cement, Machines for Sampling..... 1043
Cheese Press, How to Make a..... 1242
Chimney Remedy 348
China, Population of 451
Chisel, Core-Drawing Mortising..... 649
Chisels, To Temper Mill Picks and..... 842
Cider Mill and Press, How to Build..... 746
Circles, Center for Scribling..... 553
Circuits, Induction Tests for Short..... 144
Circular Saws, Beveled Block for Setting... 843
Cistern Cleaner, To Make a..... 250
Clamp, Convenient Polishing..... 1139
Clamp for Any Purpose, A Handy..... 1146
Clamps, Human 1243
Clamps, Pair of Home-Made..... 947
Coal, How to Measure in a Bin or Box..... 555
Coals, Boiling Kettles Without..... 448
Coil Springs, Simple Device for Making..... 555
Conductors for Electrc Lines, Aluminum.... 353
Conduits for Steam Pipe, Practical..... 948
Connector for Testing, Convenient..... 555
Coppering Steel 945

Cork, How to Turn in the Lathe..... 843
Cotton from Pine, To Make..... 447
Cotton, Machine That Picks..... 144
Crane, How to Make a Traveling..... 1146
Cripple, How to Make an Iron Boot for..... 641
Cross-Cut Saw, How to Stiffen..... 642
Cupola, How to Make a Portable..... 944
Cylinder Oil, Reservoir for Recovering..... 552
Cylinder Oil, To Recover from Condensing Engines 248
Dam, How to Build a Small..... 747
Dam Timbers, To Fasten to Rock Bottom.. 250
Drafting Board, Casting to Elevate..... 249
Drill, Electric Hand 449
Drill, Portable Electric "Scotch" 143
Drilling in Iron, A Pointer in..... 553
Drum Armatures, Simple Fans to Cool..... 145
Electrical Expressions and Their Equivalents 554
Electricity Accidents, What to Do in Case of 841
Electricity, Thawing Service Pipes by..... 1247
Electric Lamps, How to Color..... 549
Elevator, A Tool Box..... 650
Enameling Oven, How to Make a Steam-Heated 146
Engine Cylinder, Boring an..... 451
Engine, Reversing Single Valve..... 351
Engines, Simple Instrument for Aligning... 1246
Explosive, New Powerful..... 145
Filaments, Aids Incandescent..... 145
Files, Attachment for Long..... 650
Files, How to Make Pivot 152
Files, How to Soften..... 1043
Filing, Convenient Vise Arrangement for... 945
Fire Escape, To Locate in Factories..... 846
Fire Pails Were Handy 447
Fire-Proof Wood, How to..... 745
Firing Pin, Wants to Remove Broken..... 1237
Foot-Valve, Angling for..... 1240
Forge, Adjustable Brazing..... 449
Foundry, Way to Manage a..... 146
Friction Wheel Pattern, Making in a Short Time 1041
Furnace Draft, To Check Excessive..... 246
Furnace, New Rotary Melting..... 350
Furnace Pipe, How to Make Every One Heat 450
Furniture, Taking Out Bruises in..... 1239
Gasoline Engine, Attaching a Light Water-Jacket to 649
Gasoline Engine Kink 450
Gasoline Engine, Rotary 749
Gasoline Strainer, To Make..... 847
Gauge, A Marking 744
Glass, Boring Holes in..... 1045
Glass, Drilling Holes in..... 1043
Glass, How to Bore Holes in..... 847
Glass Jars, How to Cut..... 744
Glass Stoppers, Removing 1244
Glue, Cost and Handling of..... 647
Glue, How to Recognize a Good Quality of.. 1244
Glue Pot, Economical 843
Glue, Recipe for Marine 1238
Grates, Deterioration in 944
Gravel Roof, How to Make..... 1241
Grease Cup, How to Make a..... 1237
Ground Connections, Making Good..... 952
Hacksaw, A Home-Made Power..... 555
Hacksaw Wrinkle 1144
Hammer, Foot-Power 743
Hammer Handle, Improving a..... 1246
Heating Coils, Re-Arranging..... 1245
Hectograph, How to Make a..... 450
Hitching Knot, How to Tie..... 253
Hoist, An Ingenious..... 745
Horn Blower and Tire Inflater, Automatic.. 1042
Hot Water Boiler, Explosion of a..... 743
Incandescent Lamp Without Platinum..... 152
Incandescent Lights, Quick and Easy Method of Testing 946
Ink Bottle, To Keep in Drawer..... 649
Inventors, Hints to..... 449
Iron, Giving Away 245
Irrigation Congress, Echoes from..... 152
Journal Box, To Tighten Babbitt in..... 945
Key-Seating Tool, How to Make a..... 1244
Keyways, To Cut Small..... 149
Knife, Cable-Sheath-Cutting 1140
Knots and Hitches, How to Make..... 948
Knots and Miles 1046
Lathe, Burnishing Nickel Plate on..... 249
Line Repairer, Handy Device for..... 148
Log, To Measure Tapering 556
Lubricator, One for Two Pumps..... 744
Machinery, Soft Tools for Handling..... 842
Machinery, Tool for Moving..... 842
Manual Training, Value of..... 349
Marble, Removing Ink Spots on..... 846
Metal, Formula for White..... 1235
Millers, Feed Alarm for Sleepy..... 452
Motor Belt, To Tighten Vertical..... 247
Oak, How to Darken..... 1241
Oil Burners, Some Types of..... 748
Oil, Care in Burning..... 554
Oiler and Torch, Combined..... 448
Oil Filter, Home-Made 150
Oil Furnace, Melting Brass in..... 1238
Oiling System, Simple 251
Oil Production in California 151
Oil Pump, How to Make a Rotary..... 1047
Oil Stone, How to Clean an..... 550
Oils, To Test Lubricating..... 641
Overalls, Device for Washing..... 644
Packing, Simple Home-Made..... 348
Paint, Black, for Iron..... 1046
Paint for Steel Plates..... 643
Paint for Wood or Stone That Resists all Moisture 1048
Paint, Good Recipe for Heat-Proof..... 1047
Paint, How to Make Adhere to Zinc..... 947
Paper, How to Straighten..... 1235
Paste for Dry Battery 1239
Paste for Mounting Purposes..... 647
Pattern Lead 552
Pattern, Molding Shorter Than a..... 149
Phosphor Tin, How to Make..... 1243
Pictures, How to Transfer 841
Pictures, To Transfer to Glass..... 846
Pipe, Device for Bending..... 946
Pipe, Bending Cast-Iron 1152
Pipe Joints, Cement for..... 646
Pipe, Life of Cast-Iron..... 1240
Pipe, Proper Method of Bending Lead..... 1236
Pipe, Turning Large Centers for..... 148
Pipe, Steam, Piecing Out..... 1140
Pipe, Supports for Underground Steam..... 1047
Pipes, Bending Small 845
Pipes, Connecting with Right and Left Coupling 646
Pipes, Covering for Overhead Steam..... 1248
Pipes, How to Avoid "Sweaty"..... 646
Pipes, How to Bend..... 1150
Pipes, Putting Plugs in Water..... 1244
Planer Tool 951
Plaster Casts, To Toughen 744
Poker, How to Make a Light..... 145
Poles, Handy Tool for Pulling..... 841
Poles, How to Lengthen..... 947
Poles, Underground Braces for..... 1047
Polishes, How to Make Metal..... 647
Polish for Hardwood Floors..... 1145
Polish, Liquid Metal 843
Polish, Switchboard 647
Polishing Paste, Recipes for..... 451
Polishing Wheel, How to Make a..... 446
Pulley Belt, Crossed..... 842
Pulley Diameter, Increasing..... 248
Pulley Guide, Ingenious..... 352
Pulley, To Balance a Loose..... 149
Pump Rod, How Was Repaired..... 147
Punch, A Bell-Centering..... 846
Putty, Bulging 1246
Putty Heat-Proof 351
Putty, How to Soften 1249
Ram, Blacksmith's 352
Range Boiler, Repairing a..... 650
Rope Ladder, How to Make a Handy..... 844
Rubber Articles, How to Mend..... 1048
Rubber Stamps, Black Ink for..... 148
Rust Joint, How to Make a..... 947
Rust, Removing 745
Rust, To Prevent on Machinery..... 846
Rusty Screw, To Loosen..... 1249
Saw Horse for Tinners..... 556
Scales, An Improvement in..... 948
Screw Drivers, Heavy..... 1239
Section Liners, Good..... 349
Self-Centering Chuck, Faceplate for..... 847
Set Screws, Removing Stubs of Broken..... 1141
Set Screws, Shop Talks on..... 1142
Shaft Hanger, Reinforcing..... 1042
Shaft, How to Straighten a..... 249
Shafting, Rope Hoists for Handling..... 1044
Ship Telegraph Signal System for Power Plants 552

Shocking Machine, How to Make a..... 1147
Silver, To Prevent Tarnish on..... 745
Skylights, To Cut 846
Slip Lay, Marking the Hole in..... 1141
Smokestack, Lengthening While in Use.... 252
Solder for Sealing Canned Goods..... 1139
Soldering 252
Soldering Fluid, Good 1239
Soldering Iron, New..... 247
Soldering Iron, Treatment of..... 248
Soldering Solution, An Excellent..... 1045
Sparking Coil, How to Make..... 645
Spark Plugs, How to Clean..... 1140
Spark Preventer, Locomotive..... 353
Speed, How to Calculate..... 1046
Speed vs. Size 150
Sponges, To Clean..... 556
Sprains or Dislocations, First Things to Do in Case of 952
Springs, How to Harden Brass and Make... 643
Springs, How to Shape Carriage..... 1237
Standpipe, Non-Freezing 452
Steam Blower, How to Make a..... 642
Steam, Dry for Wheat Steamer..... 347
Steam Engines, Estimating the Horsepower of 1042
Steam Radiator, How to Convert into a Bake Oven 952
Steam Trap, How to Make..... 1235
Steel-Concrete Chimney, Largest in the World 1249
Steel, How to Work into Tools..... 554
Steel, New Welch Tool..... 145
Steel, Notes on 148
Steel, Preventing Rust on..... 749
Steel, Prevents Blow-Holes in..... 147
Stove Polish, How to Make..... 143
Submarine Sinks Cruiser..... 1149
Suffocation, To Revive from..... 1240
Tail Race, How to Build a Frost-Proof.... 550
Telephone, Connecting an Extra..... 645
Telephoned From a Raft in a Water Tower 1144
Telephone, How to Protect Ground Connection of 551
Telephone Testing Instrument, How to Make 250
Temper a Butcher Knife, How to..... 1152
Temper Knives, How to..... 951
Tempering Chisels, Recipe for..... 951
Tempering, Colors Used in..... 845
Tempering Recipe, Good 846
Tempering Recipe, Hunt's 952
Tempering, Simple Recipe 1240
Tempering Springs 1146
Tempering Steel Tools, Carbolic Acid for.. 846
Tempering Tools 944
Thermometer, How to Make a Curious..... 448
Thread-Cutting Kink 550
Thread, Cutting Left-Hand 245
Threads, Chaser for Cutting 1239
Tinning Brass and Copper..... 1139
Tintometer, The 1144
Tire Bolter, Handy 1048
Tire, Evolution of the 245
Tires, New Method of Repairing..... 143
Tires, To Cut Ends of Steel..... 555
Tool-Holder, A Handy 746
Tool Rack for Engine Rooms..... 641
Tools, Tallow for Cutting..... 648
Torch, How to Make of Pipe..... 1239
Trap, Electric, to Kill Rats..... 749
Trestle for the Repair Shop, Handy..... 1146
Trip Hammer, How to Make a..... 748
Truck, A One-Wheel Mill..... 844
Turbines, Professor Rateau on Steam..... 151
Umbrella Joints Need Oil..... 1045
Valve Gear, How to Deal with Worn..... 1250
Valves, Care in Attaching Brass..... 552
Varnish, Colorless 647
Varnish for Iron Work, An Excellent..... 1146
Varnish, Good Quick-Drying Carriage..... 1045
Verant—New Instrument for Photographers 353
Vise Jaws Cast from Soft Brass..... 943
Vise, Lightning Grip..... 1141
Waste Press, Simple Design for a..... 446
Water Heater, Home-Made Shop..... 350
Water, Hot for Barber Shop..... 1241
Water Jacket, Removing Lime in..... 1240
Water, Power Required to Raise..... 845
Water Pumped from Gasoline Storage Tank 554
Water, Trough, How to Construct a Cement 743
Watt, The 554
Wedge, Handy Stove Pipe..... 145
Welding Steel, Scarfs for..... 553
Weld, Right and Wrong Methods of Making 144
Weld Steam Drill, How to..... 641
When the Whistle Blows (Poem)..... 149
Whistle for Gas Engine 644
Whitewash Recipe, Uncle Sam's..... 648
Wires, To Stop Humming of..... 1045
Wood, How to Clean Polished..... 1249
Wrenches, Making Large in Emergencies.. 845
Wrench, Socket 447
Wrench, To Use as Hand Vise..... 1238

MECHANICS FOR YOUNG AMERICA.

Baggage Carrier for Bicycles, How to Make 955
Bicycle Parts, Things Boy Can Make of Old 635
Bicycle Parts, Useful Articles and Ornaments Made of Old..... 1049
Boat, How to Make a Paper..... 526
Burglar Alarm, How to Make a Simple..... 1155
Candlestick, Water 955
Clocks, "Antique," How to Make from Up-to-Date Materials 1252
Clock Dial, Lettering a..... 1254
Coasting Sleds, Chair Sleighs, Toboggan Slides, Skis and How to Make Them.... 258
Fishing, Jug 344
Fishing Tackle, How to Make Your Own... 433
Hang Heavy Things on Nail, To..... 636
Hectograph, How to Make..... 1049
Kites of Many Kinds and How to Make Them 344
Paper Balloons, How to Make..... 754
Propelling Vehicle, How to Make a..... 753
Rubber Stamps, How to Make..... 956
Something for Boys to Make..... 1153
Steam Engine, How a Boy Built One with Few Tools 1254
Street Car Line, How to Build an Imitation 837
Water Bicycle, How to Make a..... 838
Water Telescope, How to Make a..... 754
Water Wheel, How to Make a..... 529
Wind Propeller, How to Make a..... 636
Winter Sports, How to Make and Use Devices of 138

POPULAR MECHANICS, $1.00 PER YEAR
JOURNAL BUILDING, CHICAGO

Popular Mechanics

Vol. 6. No. 1. CHICAGO, JANUARY, 1904. 10 Cents a copy. $1.00 a year.

Radium, the Metal of Mystery

How It Is Obtained--Its Strange Powers and Probable Uses in the Future

By R. Rutherford

Evolution of Radio-Active Substances

Luminosity of Organic Beings, such as fire flies, marine insects, and numerous other animals emitting phosphorescent light—observed by the earliest inhabitants of the earth.

Phosphorus—discovered by Casciarlo, a Bologna shoemaker in 1602.

Uranium, forming uranite pitch-blende—discovered by Klaproth, a German Chemist, in 1782.

Fluorspar—discovered by Brewster in 1832, named by Stokes in 1852.

Becquerel radiations (emanating from uranium) discovered and named by Prof. Henri Becquerel, member of the Institute of France in 1896.

Polonium—discovered by Mme. Sklowdowska Curie, and named by her for Poland, her native land, in 1898.

Radium—discovered by M. Pierre Curie and Mme. Sklowdowska Curie in 1898.

Radium is a substance that gives off heat and light incessantly without perceptible waste or diminution of power. It comes from the earth and is extracted from ore on the same principle that gold and silver are extracted from ore. Because of its wonderful property of giving forth such enormous energy, all of its own creation and without any known outward incentive, it has been termed the "wizard metal." Though often called a metal, radium has never been secured in metallic form. It looks very much like alum or borax when crushed, and its usual form is as a chloride or bromide.

Seeming to burn forever, without ever consuming itself, to give forth light eternally without ever weakening its force, radium has baffled the scientific world, set at naught scientific theories and doctrines that men have been taught for generations and caused speculations without limit as to future possibilities.

IMPARTS ITS POWERS TO OTHER SUBSTANCES.

One of radium's most wonderful properties is its ability to impart its properties of light and heat emission to other substances. Thus a piece of wood, or metal, or substance of nearly any kind may be rendered radio-active—that is, possessed of the activity or powers of radium—by being subjected to the emanations of radium, something on the same principle that a person may make his fingers luminous by rubbing them on a parlor match. This imparted power, however, is not everlasting, but may endure for days.

MAY BE FUTURE SOURCE OF LIGHT AND HEAT.

Of course, such a phenomenal discovery as that of radium has led to dreams of a time when we may place a piece of radium in our home and thereby provide light and heat for ourselves as long as we live, and

Radium on Exhibition in Paris

for our children as long as they live, and for our children's children, and their children, and so on down the line of posterity

forever, without the necessity of ever buying another ton of coal or paying another gas bill. And our neighbor, who might not be so fortunate as to possess some radium, might send in a couple of bricks or a piece of iron to be "charged" with radio-activity enough to last for heating and lighting purposes for several days, after which the bricks or iron could again be rendered radio-active by again being exposed to the radium, without ever detracting from the original source of heat and light.

Such hopes at present seem a little extravagant, but still the partial realization of the dream does not appear impossible, nor half as improbable as a short time ago the discovery of a substance so strange as radium would have been regarded.

RADIUM JEWELRY WOULD BE RESPLENDENT.

Radium is now more valuable than diamonds. It is worth about three million dollars a pound, or more than three thousand times its weight in gold. Radium is more valuable than diamonds because at present it is much scarcer than diamonds and because it is more brilliant than diamonds. Diamonds reflect the rays of extraneous lights. Radium creates its own light and gives forth its own rays independent of outward objects. Thus when radium jewelry becomes popular diamonds will have to be relegated to the rear. A woman with radium hair ornaments, shining like electric lights from her head, will be the envy of the ballroom. A radium scarf-pin would light its wearer's way in the darkness, and in each instance the glow of the gem would never grow dimmer and would shine on forever as long as there were a grain of it left. It is possible that this may become one of the principal offices of radium until it is more plentiful, when, of course, it would cease to be prized for ornamentation.

Radium is at present very scarce. It is estimated that there are not more than three pounds in all the world. It is very difficult to obtain under existing conditions, M. Curie declaring that it requires eight tons of ore to produce one gramme of pure radium.

ABUNDANCE OF RADIUM MAY EXIST.

Radium, however, may not be as impossible as some would lead us to believe. Like everything that is only partially known, it is shrouded in a great deal of mystery. It is but natural that its discoverers should try to make it appear as rare as possible that great values might be attached to the small amount now in existence. The Curies of Paris have almost a monopoly on radium, and very little is possessed outside of their laboratory. Fabulous prices have been paid for the little that has found its way to America and other parts of the world. But if two people even with the genius of the Curies can acquire enough radium for laboratory uses, several million other people, including many brilliant minds, may be able to increase the world's supply. For now everybody is hunting radium ore, and in several instances their efforts have met with success. It has been found in several places in America and Europe, and with improved methods of extracting the valuable substance, which are sure to result in time, it does not seem improbable that all of us after a while may be familiar with the "wizard metal" and its strange powers.

Deep down in the earth there is believed to be great quantities of radium. Radio-activity has been discovered recently in a great number of mineral springs; the air from all deep borings in the earth is believed to be radio-active.

Radium ore has been found in a mine in Barringer's Hill, Llano county, Texas; Prof. Alexander H. Phillips, of Princeton University, has discovered radium in carnolite, an ore found in Utah and other of the Rocky Mountain states. Pitchblende, from which radium is extracted, is found in Bohemia, Saxony, Cornwall, Colorado and other places. Specimens from Denver have been examined recently by Prof. Curie and admitted to be of excellent quality. At Jachimsthal, Bohemia, are located the uranium mines from which is secured ore that produces fine radium.

Radium is now being manufactured by De Haen, of Sellze, near Hanover, Germany, and by Giesel, of Brunswick. New sources of radio-activity are being discovered continually, and the ore is now believed to exist in vast quantities in the earth.

EASY METHOD OF EXTRACTION SOUGHT.

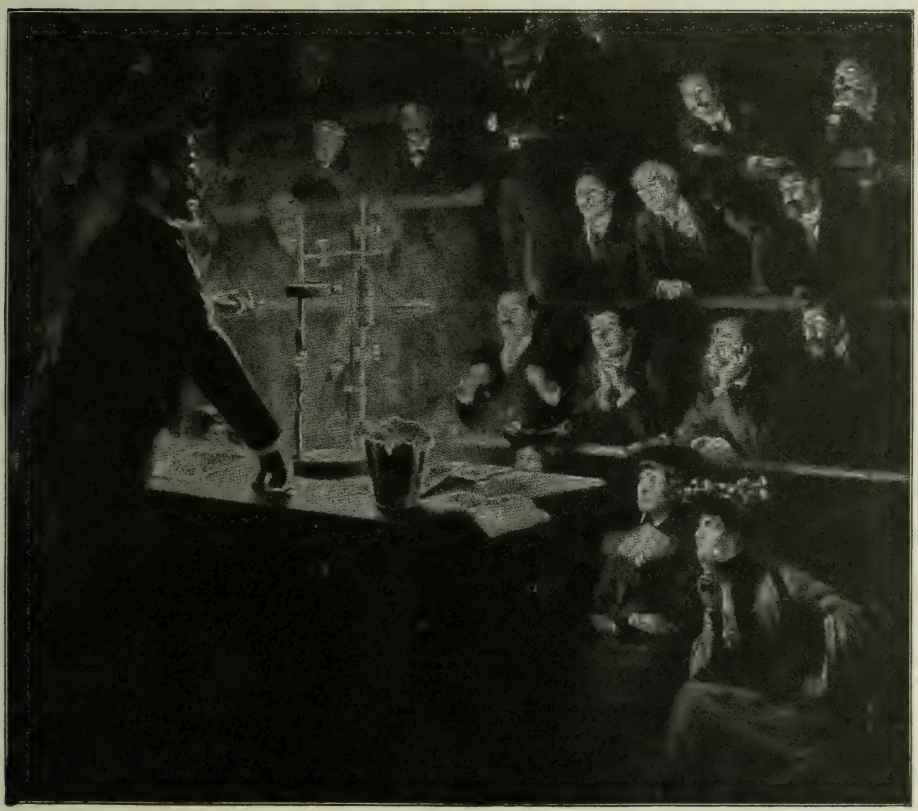
Many chemists at present are at work endeavoring to discover a single reaction by which the radium may be easily separated from the dross. The recent discovery that the gases escaping from radium changed to helium has led to the supposition that the order of things may be reversed, and radium produced from helium. It is not likely that scientists will long permit the earth to retain the secrets of radium, since the knowledge of its existence is once known. Already a cablegram from Paris

announces the discovery of a new process of extraction that will materially cheapen the precious metal.

Electrical methods are employed in detecting the presence of radio-active substances. The instrument used by the Curies is exceedingly sensitive, a million times more so than chemical analysis. Five thousand times the amount of radio-activity readily detected by the Curie electrical device would be required to show at all in the spectroscope.

The radium possessed by the Curies is extracted at the Curie works near Paris from ore that comes from the uranium mines of Jachimsthal, Bohemia. Uranium is an alkaline salt of fluorescein obtained as a brownish-red substance, which is used as a dye. It is so called from the peculiar yellowish-green fluorescence (resembling that of uranium glass) of its solutions. The ore from which uranium is extracted is pitchblende. This is essentially an oxide of uranium with slight mixtures of other substances. It is of a dull black color, and is infusible before the blowpipe, except with the use of borax, with which it fuses into a dull yellow glass. After the uranium is extracted from the pitchblende a lumpy, yellowish powder remains. From this powder radium is produced. The powder refuse was for many years regarded as waste and people were hired to carry it away. Now it is considered more valuable than the original uranite ore. The powder is shipped to the radium works in Germany and to the Curies in France.

M. and Mme. Curie Explaining the Wonders of Radium at the Sorbonne



Copyrighted 1903 by the S. S. McClure Co., Courtesy of McClure's Magazine

HOW RADIUM IS MINED.

The extraction of the radium is begun by crushing the powder and roasting with carbonate of soda. After washing, the residue is treated with diluted sulphuric acid; then the sulphates are converted into carbonates by boiling with strong carbonate of soda. The residue contains radium sulphate, which is an exceedingly insoluble salt. The

soluble sulphates are washed out, and the residue or insoluble portion is easily acted upon by hydrochloric acid, which takes out, among other things, polonium and actinium. Radium sulphate remains unattacked, associated with some barium sulphate. The sulphates are then converted into carbonates by treatment with a boiling strong solution of carbonate of soda. The carbonates of barium and radium are next dissolved in hydrochloric acid and precipitated again as sulphates by means of sulphuric acid. The sulphates are further purified and ultimately converted into chlorides, until about fifteen pounds of barium and radium chloride are obtained by acting upon one ton of crushed pitchblende. Only a small fraction of this mixed chloride is pure radium chloride, which is finally separated from barium chloride by crystallization, the crystals from the most radio-active of the solutions being selected. In this way the crystals ultimately obtained are pure radium chloride of a very high degree of radio-activity. This is the work of weeks or months, and the product may not be more than a gramme of radium.

The discovery of the radiations emanating from uranium by Prof. Henri Becquerel, and named Becquerel radiations, led directly to the discovery of radium. These radiations are used as the standard on which the luminous power of radium is based. When radium is said to possess a certain "radio-activity," say 1,000, it means that its radiations are 1,000 times more powerful than the radiations coming from uranium, or 1,000 times more powerful than Becquerel radiations. Higher intensities are produced by further crystallization. This crystallization process is carried on by the Curies themselves in their laboratory. The crude ore is first brought to a radio-activity of 2,000, after which it is further crystallized until it reaches an activity of 100,000, 500,000, and at length 1,500,000, the maximum. The specimens shown in America possess a radio-activity of from 300 to 7,000, none of more than 7,000, and hence afford but a meager idea of the real luminosity of radium. All radium of higher intensity than 7,000 is retained by the Curies for their own use.

RADIUM'S ENORMOUS ENERGY.

Efforts to increase the activity of radium or make it supply its energy at a faster rate have signally failed. If this could be done and the output of energy now being dissipated over several centuries could be concentrated into the space of a few days or weeks, its commercial use would be valuable beyond calculation. It has been estimated that the energy stored up in a grain of radium would be sufficient to raise 500 tons a mile high.

Whence does radium obtain this enormous energy in such unceasing supply? This is the question that has so far defied scientific research. Thomas A. Edison's theory which I noticed in the October issue of Popular Mechanics (Page 147), has many adherents. Mr. Edison and others believe there are rays of vibrations in ether of which man has heretofore had no knowledge, and that these furnish the power of light and heat to radium, just as tungstate or calcium are affected by X-rays. M. and Mme. Curie suppose that the atoms of radium are constantly in the state of slow evolution and transformation. The change is so slow that it cannot be detected in a year, yet the amount of energy educed in the performance is enormous. The most plausible theory seems to be that chemical changes are successively taking place in radium. This causes greater masses of material to be projected spontaneously at enormous velocity. Fresh portions continually take the place of the portions that become inert. As stated in the September issue of Popular Mechanics (Page 23), the old theory that atoms of elements consist of indivisible units of matter has been discarded by many scientists since the discovery of radium. Instead, they believe each atom is a whole stellar system of infinitely smaller, but absolutely identical units.

RADIUM RAYS ARE LIKE X-RAYS.

There are believed to be two kinds of radium rays, one of which seems to possess many characteristics of Roentgen rays. They will penetrate thin plates of aluminum, iron, steel, wood, black paper, etc. "Radiographs" taken of these substances are not unlike X-ray photographs. A radiograph of a lead box possessed by Prof. William J. Hammer shows the box nearly transparent. The radiograph was made by an exposure of nearly twenty-two hours. The rays are nearly non-deviable, as are X-rays. Glass, when in contact with radium, becomes colored. A flask containing radium will be colored to a deep, beautiful violet. Glass X-ray tubes used for some time partake of a like color.

POWERFUL HEAT AND LIGHT EMANATIONS.

Two pounds of radium placed in a room

thirty feet square would illuminate it sufficiently for reading and all practical purposes. One-tenth of a gramme will illuminate sixteen square inches of surface sufficiently for reading.

The heat given out by radium is sufficient to melt more than its own weight in ice every hour forever. In an hour a pound of radium would throw out as much heat as the burning of a cubic foot of hydrogen gas. Scientists tell us radium will never cease to give out this heat and will never be consumed.

Hence it seems that it is only necessary to get a sufficient amount of radium from the many sources already discovered in order to have heat and light abundantly and everlastingly from an apparently never-failing supply.

Besides its other strange manifestations, radium constantly gives off an emanation which seems to be a heavy gas, which can be collected in tiny flasks, measured and weighed and used to display the characteristic properties of radium, but it is not permanent. In about a month it entirely disappears. This, it is alleged, has been found to change to helium gas.

Those who most nearly hold the secrets of radium's mystic powers, however, tell us of many strange things that may hinder the use of radium for light and heat. In the first place, some say, it will never be found in sufficient quantities. Besides, they say, radium and its magic rays are deadly poisonous, yet they tell us it is a cure for nearly all ills that affect the human body. Guinea pigs, mice and other animals have been killed by long exposure to radium rays.

Radium, from what its discoverers assert, seems a thing of contradictions. It burns forever, and yet it is not fire; it will poison and it will cure; it will produce blindness and it will restore lost sight; exposure to its rays creates great sores on the body, and exposure to its rays cures the sores and affections on lupus patients; it will destroy the fur on animals and it will cause the fur on animals to grow more abundantly; it will produce premature death to insects, and it will cause insects to live many times longer than their natural life, and many other of its effects are directly opposing, according to claims that have been made by experts. The different effects are caused by the extent and nature of the exposures. Besides curing lupus patients, it has been declared that radium will positively cure cancer and consumption.

Testing Diamonds with Radium

Copyright 1903 by the S. S. McClure Co., Courtesy McClure's Magazine

Nothing known equals radium for testing diamonds. In its presence the real gems glow like flame, while the spurious diamonds are not affected in the least. The finer the diamond the more brilliantly it shines in radium's presence.

MAY BE AT LAST THE FOUNTAIN OF YOUTH.

It has even been claimed for radium that it may succeed in producing perpetual youth. This results from experiments on insects by which their development was arrested and they remained in their larvae state and lived nearly four times longer

M. and Mme. Curie Finishing a Preparation of Radium

Copyright 1903 by the S. S. McClure Co., Courtesy McClure's Magazine

PROFESSOR AND MADAME CURIE

JOINT DISCOVERERS OF RADIUM

than the natural life of the insects permitted to develop into moths. This alleged miracle is regarded by M. Curie to be as remarkable as if a youth should be similarly treated and thereby caused to live nearly three hundred years and all the time retain the appearance of a young man. By advancing the treatment some believe it might cause everlasting life. Radium has been used to cause the growth of unfecundated eggs of sea urchins and to sustain the life through development. Thus it created life from the lifeless. Experiments have shown that it will produce new forms of life, different from any known to science before. Tadpoles, that were treated, failed to produce frogs, but instead developed into strange looking monsters, unlike either the tadpole or the frog.

Thus it is believed by many that this remarkable discovery may hold within its mysterious powers the very secrets of life and death; that it may reveal the secrets of the origin of life, and permit the artificial or chemical production of life; that it may enable man through the treatment of chemical substances as readily to produce a mechanism that breathes and lives as he now manufactures a clock that ticks and measures the hours.

These claims for radium are made by very eminent authorities, many of them by M. and Mme. Curie, themselves, but all of them of course cannot be credited.

Radium is a very mysterious substance—in fact the most mysterious that has ever been discovered or produced and the very fact of its mysteriousness, doubtless, has led to the suspicion of numerous magic powers it might yet possess.

IS RADIUM A PERPETUAL MOTION?

The facts known regarding the strange substance are that it gives out heat and light and a strange gas incessantly, seemingly forever, in undiminishing quantities, without ever losing a particle in weight, without ever depreciating in power. Perpetuity is difficult for the human mind to comprehend and it seems unnatural, as all we have hitherto known in nature has a beginning and an end, but radium's powers seem perpetual. None has so far been able to discover positively that they are not. Prof. Curie thinks it possible that in a thousand million years a gramme of radium might lose one-millionth part of its bulk. Others say a ton might lose an ounce in ten thousand years, but there has never been a perceptible loss in the weight, bulk, or force of radium, on which such estimates could be based.

Therefore radium is more wonderful than perpetual motion for it seems to be perpetual motion and more. The fairy story in our school readers of the machine that makes the sea salt by continuously grinding salt is not half so strange as the true story of radium, the "magic metal" that seems to produce light and heat forever and never loses force or weight.

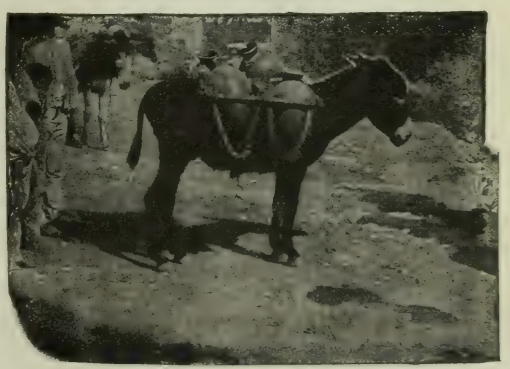
Parisians are already becoming tired of the auto fad, and are turning eager eyes to ballooning.

A share in a Russian vessel can be acquired by a foreigner only by inheritance, and then only on condition of transfer to a Russian subject within two years after the death of the testator.

Prof. Richards, of Lehigh University, says that the waste gases from a modern blast furnace are capable of developing 10,000 horsepower if utilized in suitable gas engines.

CARRYING WATER IN MEXICO.

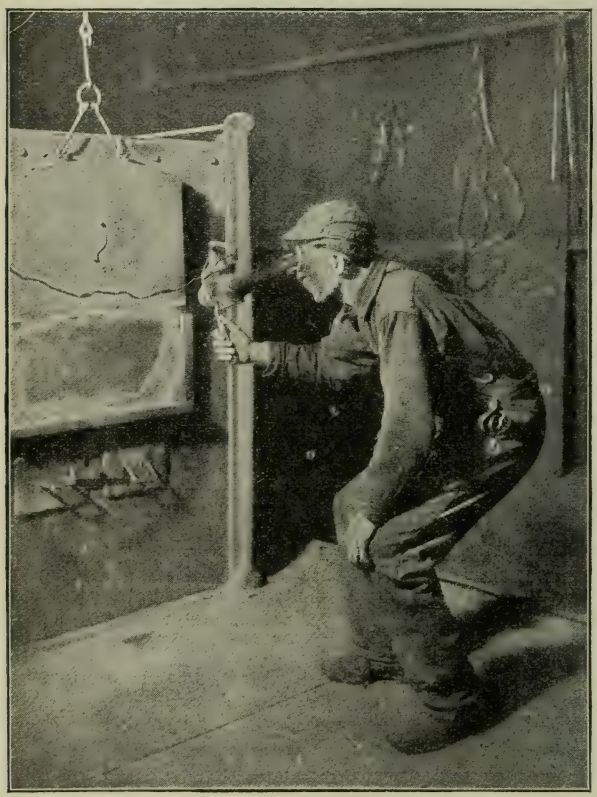
In early days of Mexico and Western Texas and even yet in Mexico, the carrying of water is an important problem. Sleds and wagons equipped with barrels are used in some places, but the primitive method and the one now in vogue in many parts of Mexico is the burro and the Mexican water jars. The jars are strapped on either side of the animal's back. Often the water for the entire community is in this manner packed from a well or spring miles away.



How Water is Carried in Mexico

Instrument Shows the Heat of Steel

An instrument has been perfected which shows at a glance how hot a mass of steel is, without using a thermometer, and its accuracy is remarkable. It will not vary 5 degrees in 1,000. The indicator can be used in a great variety of purposes for the lead bath, on a blacksmith's fire, or with a heating furnace, as shown in the illustration.



Heat Gage as Used with a Heating Furnace

A short telescope tube contains an incandescent electric light, having its filament arranged in spiral form. This is connected to an ammeter, and rheostat by means of which any desired current may be switched on the lamp. A table gives the heat equivalent of various degrees of incandescence. When current is on the lamp and the instrument pointed at the heated object, the spiral will appear brighter or darker than the object viewed according to the greater or less amount of current in the lamp. The rheostat is set to the proper current to give the desired heat in the metal, say 900 degrees. When the filament shows no brighter or darker than the metal the object has reached the 900 degrees. The instrument, which may be set to show any desired temperature, is named the Morse thermo gage, and is fully covered by American and foreign patents.

BANQUET IN A SEWER.

Mayors of Iowa enjoyed a banquet in a sewer a short time ago. The subterranean feast was at Waterloo, Ia., whose mayor and city officials acted as hosts. The occasion was the completion of the great work that will give Waterloo one of the finest sewage systems in the country.

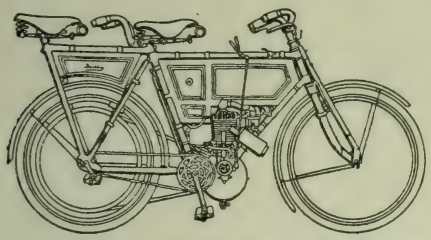
An immense concrete storm drain, built to protect the city from the western water shed, served as the banquet hall. The arched drain is twenty-two feet below the surface of the earth and is in the shape of a letter "D" lying on its flat side. A table 350 feet in length was spread in the center of the arch and 150 mayors of Iowa cities and 200 of the leading business men of Waterloo were seated at it. The speakers were stationed at the ends of the tables and could be distinctly heard by all. Dry Run sewer is 3,585 feet long, twelve feet wide and twelve feet high. Over 6,000,000 pounds of cement were used in its construction and the greater part of the excavation was made through solid rock. Its entire length is through a populous portion of the city.

In changing from the liquid to the solid state and cooling down to lower temperatures, steel crystallizes in planes at right angles to the cooling surfaces and shrinks from 3-16 to 5-16 of an inch per lineal foot.

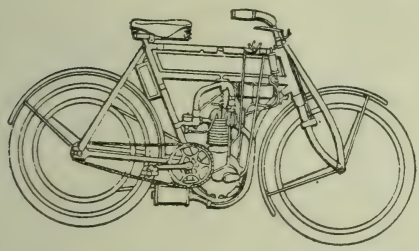
Motor Cycling a Coming Fad

Display of These Machines at Recent London Auto Shows Causes Great Surprise

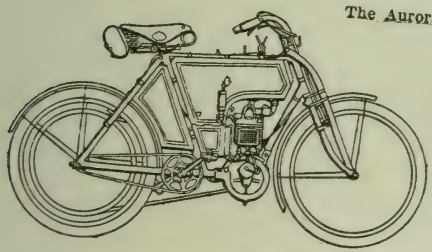
Unless all signs fail the motor bicycle is destined to have its turn as reigning mechanical hobby in 1904. Two notable exhibits have been held in London: the Stanley in Agricultural hall, and the National in Crystal Palace. These shows were ostensibly exhibits of motor cars. They were what the people came to see: instead they found style after style of motor bicycles of every name and description. Their number was even a surprise to the exhibitors themselves. One hundred and twenty were the separate and distinct firms and exhibits of these two-wheeled racers which promise to become as thick as horseflies



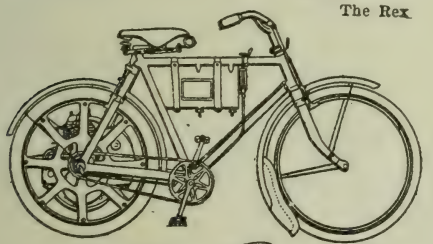
The Bradbury Peerless Tandem



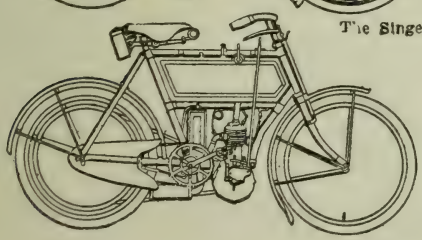
The Aurora



The Rex



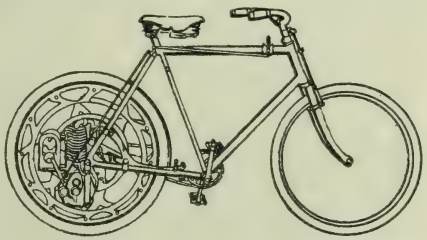
The Singer



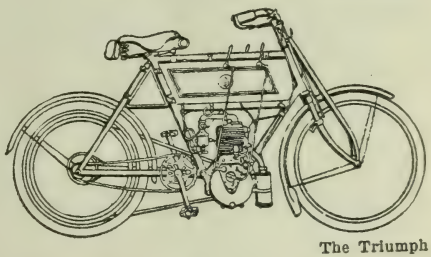
The Ariel

As the bicycle and automobile came to us after having won their spurs in Great Britain, so we may expect the same course to hold good in the case of the motor bicycle.

The few companies thus far building such machines in this country have met with a fair degree of success in producing serviceable machines, but there is no concealing the fact they have yet a lot to learn before the motor bicycle becomes a household necessity. The demand has been fully equal to the supply, however.



The Buckley



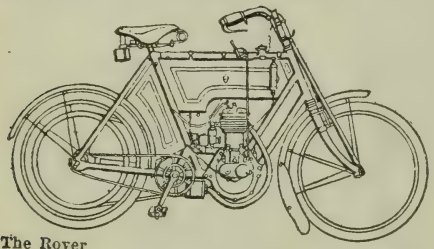
The Triumph

Owing to lack of space and the necessity to economize weight the motor bicycles have not been as dignified in their operation as the autos, and the exhaust is painfully disagreeable. They easily get out of repair, owing to the jolting the machines receive, and altogether the American machine has room for much improvement.

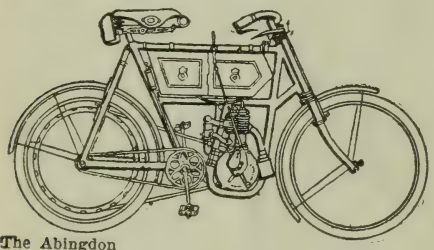
"The motor bicycle displays show several decided tendencies in construction," says the

Motor Age. "One is toward spring forks, these being incorporated in the trussed fork, which is almost universal in England. Another and with less apparent desirability, is toward water cooling. It is probable this will never become general on light machines. Mechanical inlet valves are among the motor improvements, while magneto instead of batteries and coils is a prominent novelty.

Motor tricycles are quite in favor abroad, which on account of their excellent roads, give good satisfaction. Two-speed gears are provided, and special attention is given to securing an effective brake. The illustrations show some of the best types and are taken from the journal quoted.



The Rover

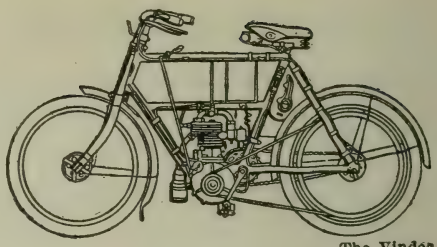


The Abingdon

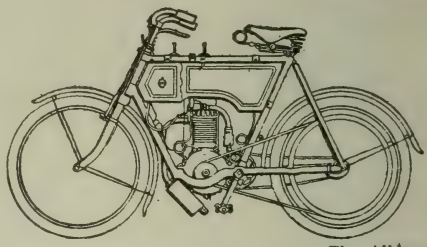
"HELLO" IS UNIVERSAL WHEREVER THE TELEPHONE IS USED.

The telephone has made the word "hello" a universal greeting in every place on the globe where language is spoken by wire. All languages, English, German, French, Spanish and the thousand and one others are transmitted faithfully by the telephone, so that the interpretation of the telephone might be said to be universal. No matter, however, what the nationality of the speaker may be or what vernacular he may employ, every telephone message in all languages is preceded by the great American "hello."

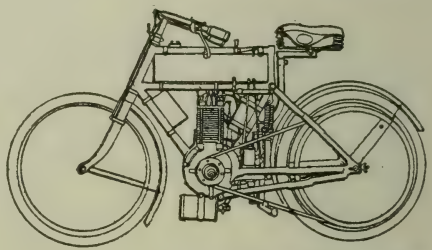
The Pennsylvania railroad has installed a long distance telephone system connecting Pittsburg and Philadelphia, at a cost of $75,000, exclusive of poles. The line will be the most expensive ever built, the wires being copper of unusually large size.



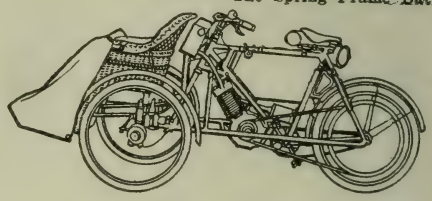
The Vindec



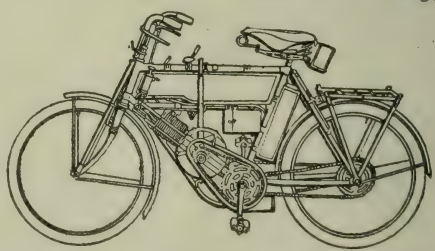
The Alldays



The Spring Frame Bat.



Excelsior Fore-Carriage



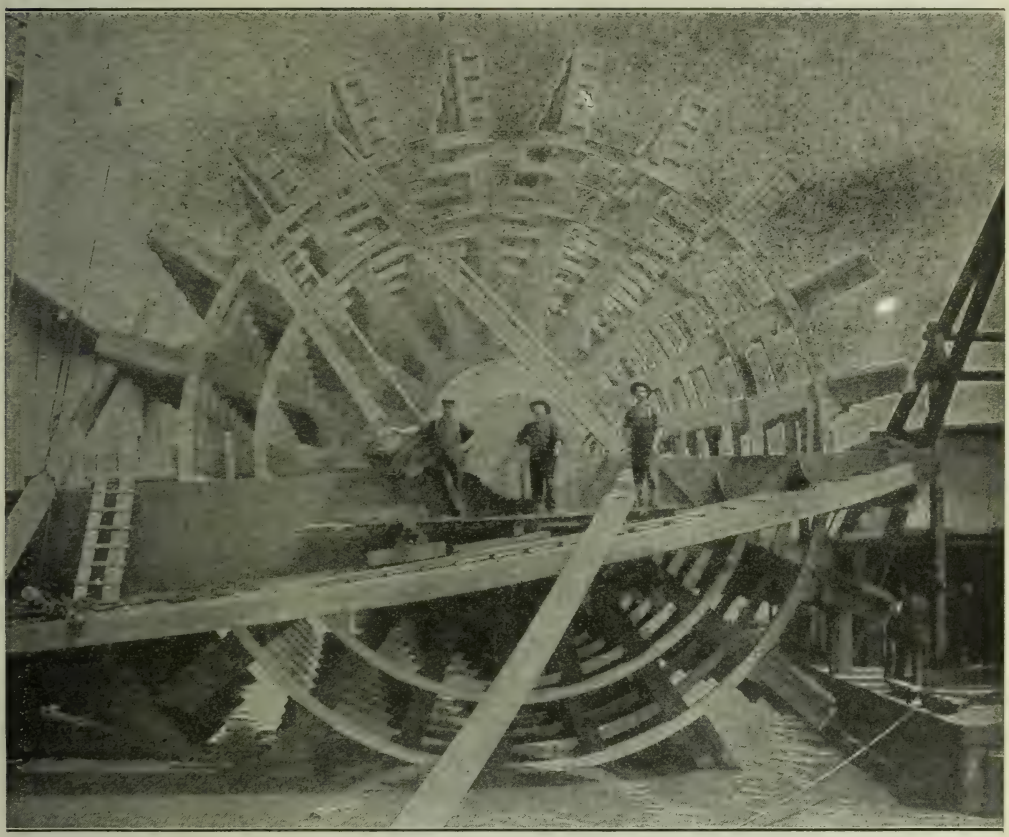
The Humber.

LARGEST CIRCULAR SAW.

The largest circular saw in the world has just been made in Philadelphia. It is 7 feet 4 inches in diameter, bears teeth 4 inches long, and weighs 305 pounds. It will be used to cut pine stumps into shingle bolts.

Enormous Stern Wheel of the Sprague

It Propels the Largest Towboat Ever Built--A New Giant of the Mississippi



Stern Wheel of the Steamship Sprague—40 Feet in Diameter, 4 Feet Wide by 40 Feet Long

Propelling the largest river towboat ever built, the stern wheel of the giant Mississippi river steamer Sprague is probably the most colossal construction of the kind to be found on any waters. The wheel is 40 feet in diameter, equipped with 21 buckets, each 40 feet long by 4 feet wide. The Sprague has just been launched at Dubuque, Ia. An idea of the immense size of the wheel can be obtained from the illustration, which shows the comparatively small stature of the men standing near its center.

The wheel shaft is of hollow forged nickel steel, the outside diameter being 31 inches; diameter of the hole 21 inches at the center and 10 inches at the journal. The length of the shaft is 47 feet 2 inches and it weighs 80,220 pounds. It is fitted with eight cast steel flanges, to which are attached the spokes of the wheel.

The Sprague is employed in taking down river great fleets of coal barges.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

An American manufacturer recently received an order for a lathe warranted to make a chip 1 inch deep, with a feed of ⅛ inch, with a speed of 130 feet to 150 feet per minute.

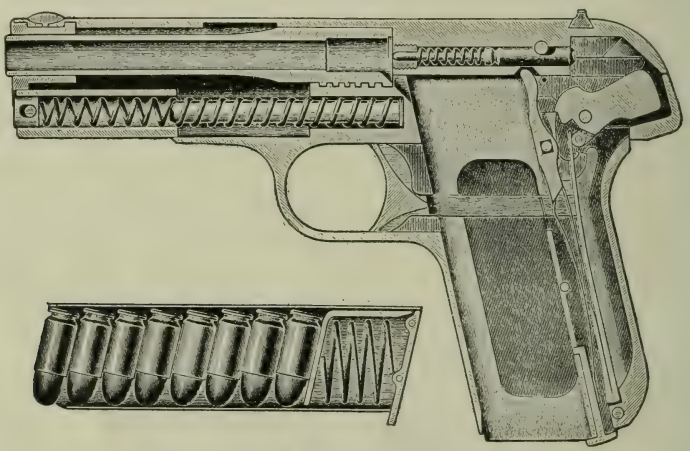
The Magazine Pistol, An Instrument of Death

Deadliest of Fire Arms Seems Almost Animate In Its Ingenius Mechanism

On pulling the trigger the cartridge is fired, the empty shell extracted, a new cartridge loaded into the chamber and the indicator shows that one cartridge less remains in the magazine. All this is done automatically in the twinkling of an eye, in the instant while the trigger is being pressed. Such is the triumph in the manufacture of small fire arms that has been attained in America and that is exemplified in the new Automatic Magazine Pistol, the most deadly weapon known. Firing eight shots without reloading and in quicker succession than is possible with any other weapon outside of the artillery, this little weapon, only seven inches long and weighing but 23 ounces, is a veritable battery within itself. Although it has been on the market but a few weeks, its fame has spread all over the world. While in many localities it has become the pride of the outlaw and the terror of the law-abiding, it has in numerous instances served as worthy protection against culprits and a valuable weapon to the police. More murders can be traced to its death-dealing missiles than to any other source since its dashing debut into the world of crime. True in its aim, fearful in its force and instantaneous in its action, it is unrivaled in the present day as an instrument of death. The magazine pistol has been known to kill a man two blocks away.

The cartridges of the automatic revolver are supplied from a detachable magazine inserted in the handle. They are loaded with smokeless powder. The automatic operation is effected by the recoil of the moving parts, and as a consequence the recoil is so absorbed in being utilized that it has no disturbing effect.

The main parts of the pistol are the receiver, the barrel and the slide. The receiver has suitable guides for the reciprocating slide. The magazine is inserted in the hollow handle from below and there held by the magazine catch. When the catch is released the magazine may be drawn from the handle for recharging. In front of the handle is the trigger guard in which the trigger is located; in the rear and above the handle is arranged in the receiver the firing mechanism, consisting of the hammer, the sear, a safety device and the main spring; also the sear, safety and trigger spring. Upon the barrel are transverse ribs and on the frame are corresponding recesses. These serve to engage the barrel firmly in the closed position.

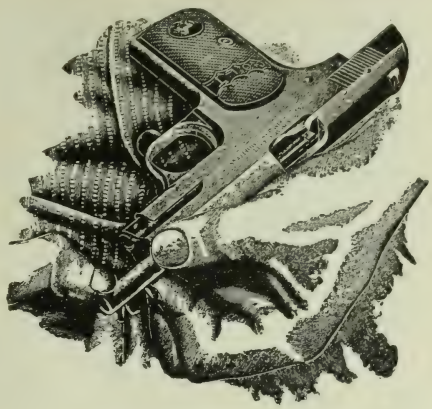


Showing Interior Construction of Magazine Pistol

The magazine is a tubular holder in which the cartridges are placed, one above the other, resting upon a follower, which is acted on by a spring passing upward. The upper end of the magazine is open to permit the escape of cartridges; the side walls at the rear of the opening are turned inward and engage the rim of the topmost

cartridge to prevent its escape from the magazine when it is pushed forward. The slide of the pistol has been machined out, leaving the solid metal for the breech block. As the slide and breech-block are one solid piece and the slide is slipped on from the forward end, it is impossible for powder-gas or powder to come backward through the arm. The magazine has holes drilled in the sides, which act as indicators to designate the number of cartridges in the magazine.

The pistol is provided with a safety device which makes it impossible to release the hammer unless the slide and barrel are in their forward position and safely closed; this safety device also serves to control the firing and to prevent more than one shot from being fired for each pull if the trigger. It consists of a small vertical piece mounted in front of the sear in the receiver, the end of which slightly projects from the top of the receiver; in its raised position when the bolt and slide are closed, it finds a corresponding recess in the bottom of the bolt. In its raised position the safety piece does not interfere with the operation of the trigger, but when the slide is moved rearward, the bottom of the bolt depresses the safety-piece which, in that position, prevents the movement of the trigger from operating the sear, and thus the hammer cannot be released until the slide is again in its forward position, locked to the barrel.

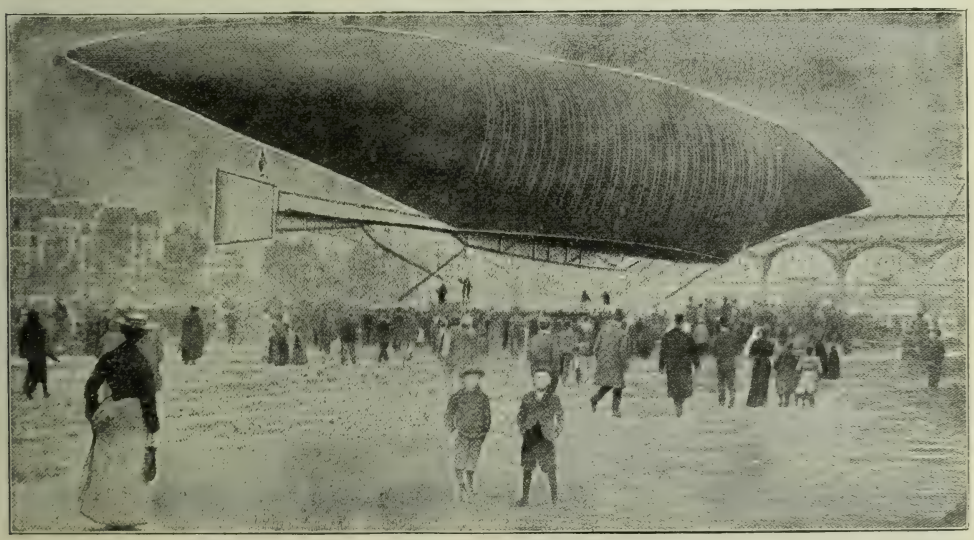


Assembling the Magazine Pistol

Santos Dumont Has Two Rivals

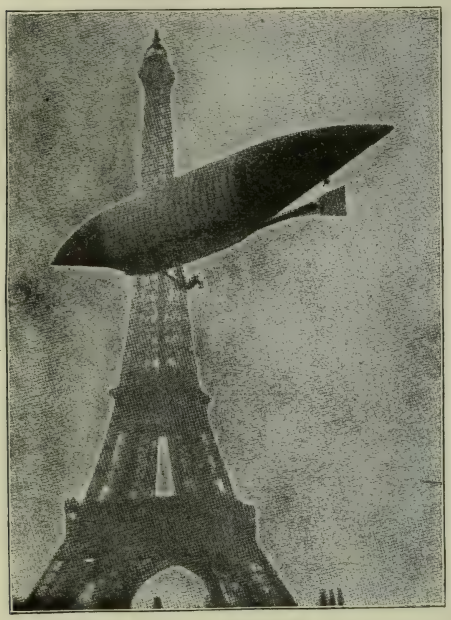
Labaudy Brothers Fly About Over Paris in a Remarkable New Airship

Two new aeronauts, rivals of Santos Dumont, have made their appearance in Paris. They are MM. Pierre and Paul Lebaudy, cousins of M. Jacques Lebaudy, the "emperor of Sahara," who was pictured in the December issue of Popular Mechanics. The Lebaudy dirigible balloon, the "Jaune," recently made a remarkable trip in Paris. It traveled about over the city from Moisson to the Champ de Mars.



The Start

The Lebaudy airship is 183 feet long and 33 feet in breadth. The frame is 70 feet long and nearly 20 feet wide. The car is



Airship Passing Eiffel Tower

16 feet long and five feet broad. It has two sets of steering-gear and two screws worked by a 40-horse-power motor.

A great crowd watched the balloon as it majestically rose, swept past the Eiffel tower and seemed to move in perfect obedience to the aeronaut's guidance until it finally struck a tree on being lowered to the ground and was demolished. The accident, however, is looked upon more as a fault of the steersman than of the airship, and great things are expected of the Lebaudy's next attempt at air navigation.

The Finish

TO PREVENT ECHOES IN CHURCH BUILDINGS.

Editor Popular Mechanics:—Can you kindly give me some information on how to improve the acoustics of halls, churches, etc., by stringing wires from wall to wall. In our church here there is a bad echo that makes hearing very unsatisfactory. The church is plain 30 by 50 feet. The walls are 18 feet high. The ceiling is arched so that in the center of the auditorium it is about 22 feet from the floor to ceiling. The church has no carpet.

A. Lunde, Great Falls, Mont.

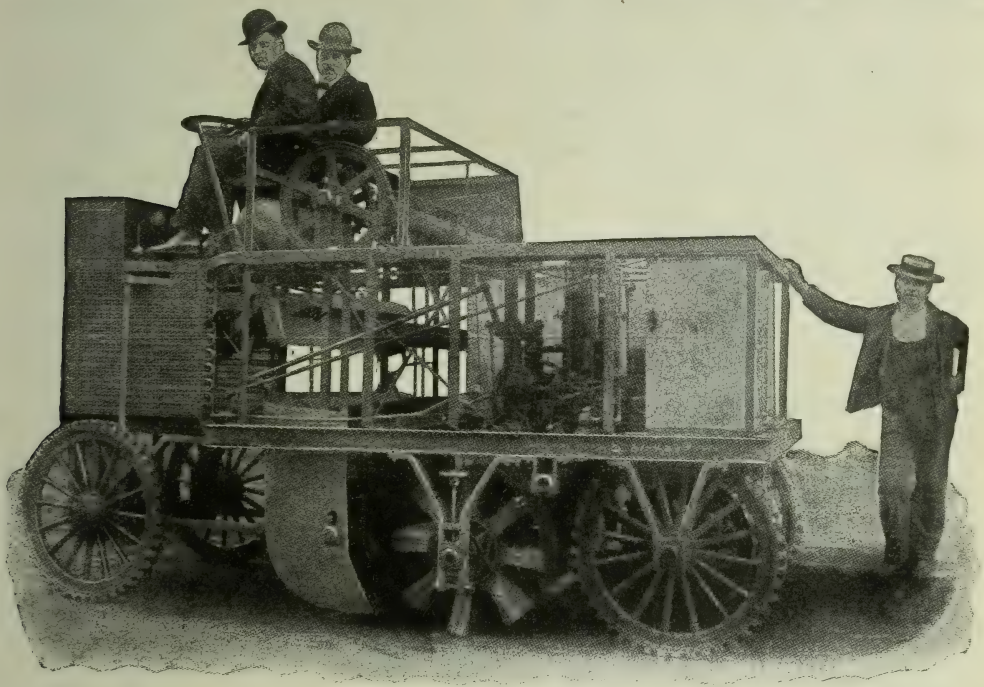
—First try a carpet in your church, if nothing more than for the aisles. This alone may stop the echo. If not try hanging draperies at the rear of the hall, when you will in all probability discover that the trouble has ceased. It is absolute bareness of the auditorium that causes the echo. Draperies at the rear will intercept the sound waves before they reach and rebound against the hard bare wall opposite the pulpit. You probably will not need any wires. If you should find that the carpet and the draperies do not give relief, however, you migh experiment with stretching two or three dozen fine wires across the hall from side to side, fastening the wires above the window heads. The best location for them should be determined by the experiment producing the least echo. The kind of wire is immaterial as its office is merely to serve as an obstruction to the sound waves. The acoustic powers of your church might further be improved by erecting a sound board to the rear and above the minister's head so as to throw the sound waves out toward the audience and prevent their going up to the ceiling over his head. The building interior with the best acoustics is shaped nearest like a trumpet. It should be narrow where the speaker stands with no means for the sound to escape above and to the rear, and broadening and widening out in front as the distance from the speaker increases. This is the way all modern theaters are built, notably the Auditorium in Chicago, and the same principle is being followed in the construction of modern churches.

The Massachusetts Institute of Technology the great engineering school of Boston will confer degrees of doctor of engineering and is the first school that has yet been officially established for graduate students of technological subjects.

Here It Is At Last

A Noiseless, Dustless, Horseless Street Sweeper

Now comes a phenomenal genius—John S. Muir is his name—who claims that cities are wonderfully antiquated in having two separate machines for sprinkling and sweeping the streets. He has consequently combined the sprinkler and the sweeper into one huge combination that is supposed to do all the work necessary for keeping streets in perfect condition, as it rolls along at a speed of eight miles an hour, leaving no dust or dirt in its path. Neither does the belated homecomer need fear strangulation from dust as this remarkable machine sweeps by, for this sweeper makes no dust. It sprinkles the dust before it sweeps it, or rather gathers it up into a reservoir and hauls it away.



Steam Street Sprinkler and Sweeper

No horses are employed by this machine to belitter the streets as they are cleaned. The combination street sprinkler, street sweeper, street washer, et al, is operated by steam. It is a kind of an automobile street cleaner. So the man who cleans the streets in the future may boast riding in an automobile. It is a noiseless, dustless, horseless, device.

The machine is equipped with a 10 h. p. valveless steam engine and boiler and a 10-horsepower boiler. It is 15 feet long, 6 feet wide, 7 feet high, and weighs 5,840 pounds. The machine, it is claimed, can do the work of twenty men. The fuel is either gasoline or kerosene, of which 28 gallons can be carried. The sprinkler tank holds 109 gallons.

The two men sitting in the seat of the sweeper are the renowned president and secretary of a company interested in its manufacture looking for a city to adopt the machine for public service. As yet it has not entered into general use, but municipal heads are noted for their stupidity in recognizing ingenious conceptions.

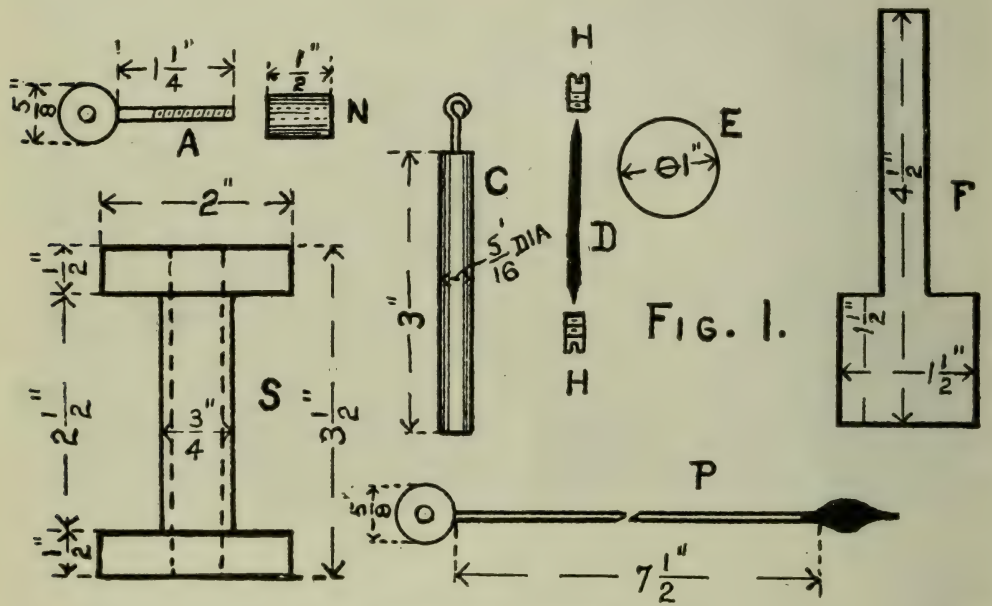
From among the hundreds of letters of commendation received we select the following: A subscriber from Ft. Smith, Ark., writes:

"Popular Mechanics, as the editor says, is 'written so you can understand it.' I work for a power company in this city, and when I receive my magazine every month it's a scramble between the boys to see who reads it first. Seven have already promised to subscribe."

EASY ELECTRICAL EXPERIMENTS

AN AMMETER FOR ELECTRO PLATERS.

The writer recently constructed the ammeter described in the following paper, and its operation has been so satisfactory, it is thought that a description of the instrument will be of interest. Ammeters are often desired for purposes where the instrument may be placed upon a wall, and whose readings need be only approximately correct. The instrument to be described is essentially a wall instrument, and its readings



Showing Parts of Ammeter.

may be relied upon to an accuracy of five per cent.

A view of the complete instrument, with the exception of its outer case, is given in Fig. 2, and a view of its several parts is given in Fig. 1.

A hard wood spool of the dimensions shown at S will be required. This may easily be turned on a lathe. A hole ½ inch in diameter should be bored lengthwise through the center of the spool. When this spool is finished, it should be wound full of No. 10 double cotton covered magnet wire. This size of wire is suitable for an instrument whose maximum reading is 25 amperes. If a lower reading instrument is desired, smaller wire may be used. Number 12 wire gives an instrument with a maximunm reading of 15 amperes.

When the coil is wound, fasten the ends tightly, leaving one foot of each end loose, and give it two coats of heavy shellac, and set aside to dry.

Procure a smooth well finished board, 12 inches long, 7 inches wide and ⅞ inch thick. At a distance of 2 inches from the left hand edge, draw a line the whole length of the board, parallel to the edge. Upon this line, with its center 4 inches from the bottom, mount the coil just constructed. The projecting wires should be pushed through two holes in the board so that they stick out at the back, and the coil should lie close against the board. Then two brass straps passing around the spool at the top and bottom, and screwed to the base-board, will secure the spool firmly to the board. The projecting wires may then be brought down to two binding posts at the bottom, which are not shown in the cut.

The coil is to act upon an iron core, which is shown at C, Fig. 1. It is made up of a tight bundle of number 20 B. & S. iron wire. This wire should be very soft and straight, and the bundle should be bound together with strong thread. The central

wire is left projecting at the top to form a hook by which it may be suspended.

Next cut out a piece of sheet brass shown at F. The projecting tongue is to be bent twice at right angles, as shown in Fig. 2, so as to form a support for a small shaft pivoted in bearings which are screwed into the brass support. The tongue is first bent sharply at right angles, close to the back. Then at a distance of ⅞ inch from the end, it is bent down again. A small steel shaft shown at C is next constructed. It is 2 inches long and ground to a fine point at each end, to fit into two conical bearings, in exactly the same manner that the balance wheel of a clock is supported. The shaft may be about 3-32 inch in diameter. In the brass support just described mount the small bearings shown at H. These have conical cups turned on their ends, and are threaded so as to screw into holes drilled in the brass piece F. The shaft should lie at a distance of ⅝ inch from the projecting brass tongue, and should turn with very slight friction indeed. The pivots should be hardened to decrease friction.

Upon this shaft are to be mounted three things. First, the brass pulley shown at E, which is ⅛ inch thick, and has a groove turned in its rim. Second, the brass weight shown at N, and its support A. The latter is made by turning a small brass disc ⅝ inch in diameter, into the rim of which is screwed a projecting brass rod, threaded, upon which screws the weight N. The supporting disc should be provided with a set-screw, so that it may be fastened upon the small shaft in any position.

In a similar manner, a wire pointer shown at P is constructed. It is supported on the shaft by a brass ferrule, and carries at its outer end a black pointer cut from a piece of thin aluminum.

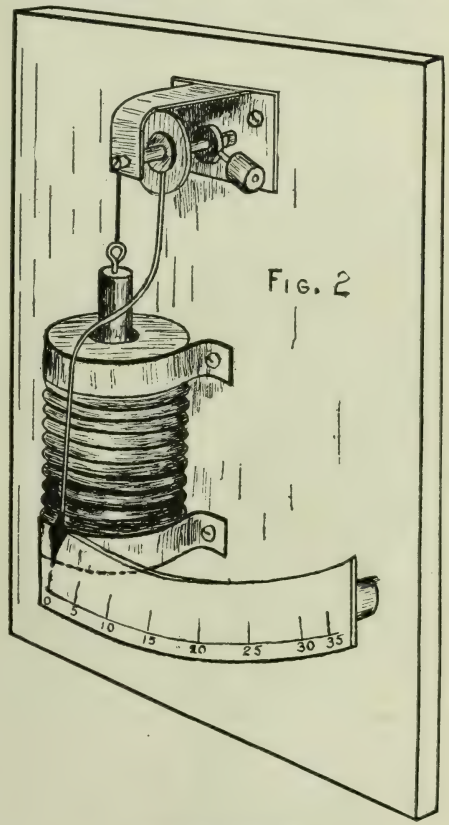
The wheel E makes a driving fit upon the shaft, and should be at a distance of 1 inch from the base board when the brass support is screwed to the latter. The pointer slips on in front of the wheel E, and the counterweight is behind the wheel.

Mount the brass support, with its supported shaft, pointer, and counterweight, at such a height that the shaft is 4 inches above the top of the coil, and so that a vertical line through the rim of the little pulley will pass through the center of the spool of wire.

Then hang the iron core, by a silk thread, so that the thread passes around the brass pulley, and allows the iron core to hang freely with its lower end just inside of the spool of wire. A small brass hook soldered to the rim of the wheel, on its under side, will furnish a convenient means of fastening the thread. The wire pointer will have to be bent so as to clear the spool, and the counterweight adjusted so as to bring the pointer to rest in the position shown. Every thing should swing very freely, and the pointer, when disturbed should come back after a few oscillations, to the same point each time.

A circular scale, cut from a piece of white bristol board, is secured behind the pointer.

To calibrate the instrument it must be placed in series with another standard in-



Ammeter Completed.

strument. The reading of the latter is marked upon the paper scale, and this process repeated for each point desired.

A neat wooden case may be made, with a glass front, adapted to slip on over the moving parts of the instrument, being secured to the baseboard by two hasps and dowel pins. The instrument should be firmly screwed to the wall in a vertical position.

When a current is sent through the coil it attracts the iron core, drawing it down into the coil. This causes the pointer to move toward the right, lifting the pointer and counter weight. The stronger the current, the further will the pointer be moved. The instrument will work equally well on alternating and direct currents.

GRAMAPHONE RECORDS FOR WIMSHURST MACHINE.

One of our readers, H. E. Hanna, who built the Wimshurst machine from description given in November Popular Mechanics, says: I recently constructed a Wimshurst machine and for the disks I used two 10-inch gramaphone records. The ones I used were badly worn and were useless for musical purposes. Old records may be obtained from most any dealer in gramaphones. A statical machine with disks of this sort should not be placed in the sun or a very warm room, as the disks will warp when subjected to any great heat.

For a condenser I dispensed with the bottles and used a condenser similar to an induction coil condenser, which is more easily constructed than the bottle form. If you will publish the above it may aid some of the amateurs who attempt the construction of the machine.

I am 17 years old. I have constructed a wireless telegraph apparatus which works fine, and have applied for a patent on an ingenious little electrical contrivance by means of which patrons of the rural routes are warned by the ringing of an electric bell, located at a convenient place in the house, when mail has been placed in the mail box.

NEW ENGLISH CRUISER "HAMPSHIRE."

The new English cruiser "Hampshire," which was launched September 24 is 450

Cruiser Hampshire.

feet long, 68 feet beam and draws 24 feet 9 inches of water; it has a displacement of 10,750 tons. A belt of armor tapering from 6 to 2 inches surrounds the vessel. The Shipping World, London, says: "The Hampshire is armed with two 7.5-in.; ten 6-in.; twenty-five smaller quick firing guns, and two submerged torpedo tubes.

OPENS DOORS AUTOMATICALLY.

When the waiter nears the door it opens automatically to permit him to pass and then closes itself, noiselessly and promptly. No longer does the crashing of breaking dishes startle the patrons of hotels and restaurants equipped with this novel device.

Automatic Door Opener.

The waiter is saved the annoyance and risk of using one hand to open the door while he carries a tray of dishes in the other.

The "automatic door opener" is a new invention, which at present is used principally in hotels, restaurants and club houses, but its field promises to spread until it is employed in all kinds of establishments. Its mechanism seems destined to take the place of the hotel footman and the "door boy," now employed in large stores. The hidden springs and levers that manipulate the entrance perform their functions more accurately and untiring than either the footman or "door boy."

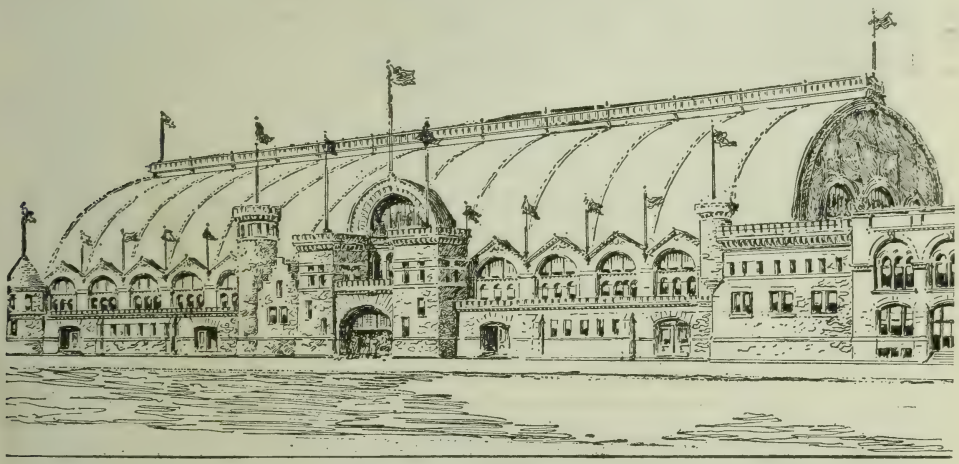
It is the touching of the foot to a platform extending on either side that causes the door to open. This platform is raised about an inch above the floor and is connected by simple levers and a spring concealed underneath.

In the City of New York there are only 737,477 white persons born of native parents.

Greatest Convention Hall in America

Chicago's Coliseum, Where the National Republican Convention Will Hold Forth

The Coliseum in Chicago, which will house the national Republican convention June 21, is the greatest convention hall in America. It has a memorable history, being a transformation of the famous old Libby Prison, which was bodily reproduced for the world's fair. Its present seating capacity of 10,000 will be increased to 15,000 for the occasion of the convention. Spectators, who often have been denied the privilege of watching the deliberations of conventions, will be enabled to witness the proceedings of choosing the Republican party's leader for the ensuing campaign.



The Coliseum of Chicago

The great Coliseum is within four blocks of Lake Michigan. The cool lake breezes will make the atmosphere pleasant on the warmest day. It is ventilated from the roof, under which there are scores of windows. The building is lighted by an immense plant which was installed at a cost of $50,000 and which furnishes light for thousands of electric globes. The acoustics are excellent. The building, while fireproof, is so constructed that it can be emptied in six minutes in case of emergency. There are twelve large exits, consisting of double doors. Twelve thousand dollars are to be expended in improving the structure for the occasion.

This will be the tenth national convention to be held in Chicago, which has thereby earned the title of the Convention City. Abraham Lincoln was nominated in Chicago May 16, 1860. It was here that Ulysses S. Grant was nominated in 1868, James A. Garfield in 1880, James G. Blaine in 1884, and Benjamin Harrison in 1888. General George B. McClellan was nominated by the Democrats in Chicago in 1864, Grover Cleveland in 1884, Grover Cleveland again in 1892, and William J. Bryan in 1896.

GERMAN FUEL BRIQUETTES.

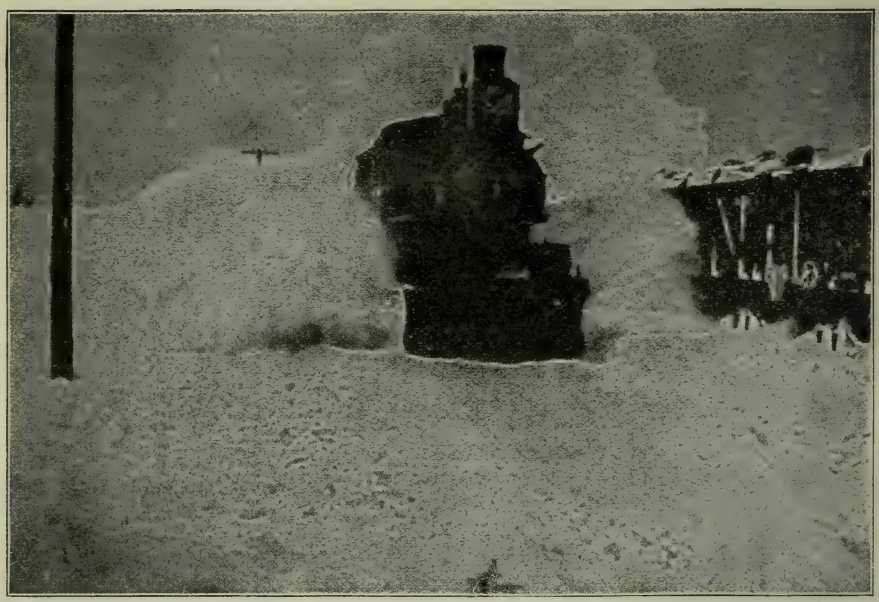
One kind of German fuel briquettes is manufactured by mixing petroleum with rosin and heating; sulphuric acid is then added and the temperature raised to a boiling point. After grinding the slaked lime and the addition of solid fuel, the whole is formed into briquettes. If required for smelting purposes the powdered ore may be incorporated with the mass previous to the briquetting operation. Small lumps of the fuel may be used as fire lighters.

Nickel steel is being used for most of the tension members and pins of the great cantilever bridge now being constructed at Blackwell's Island, New York city.

Automobiles for use on railroads are now the raging fad in Vienna and Budapest, and factories are being crowded to fill orders.

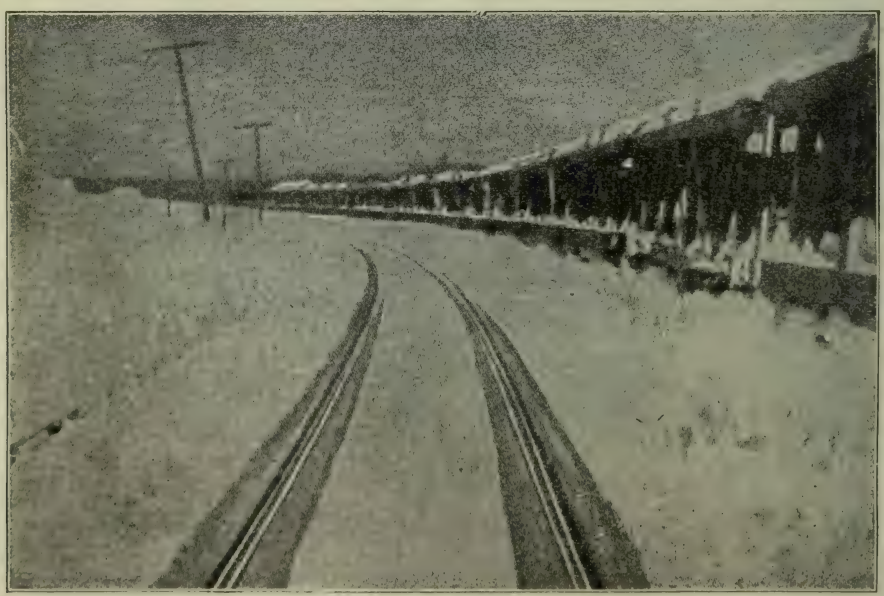
Battling a Blizzard in the West

A Snow Flanger at Work



Track Before Flanger Equipped Train has Passed

The flanger is attached between the front truck wheel and the pilot and is supported directly on the truck. The knives, made to cut the hardest snow are placed about one inch above the rail. The flanger is operated by means of an air cylinder controlled in the engine cab. The passenger train equipped with the compressed air flanger will readily run through 12 inches of hard packed snow and sand. A freight engine will pull its usual winter load under the same conditions with but slight reduction of cars.



Track After Train Has Passed Over Using Flanger

Three Days' Terrible Battle With a Blizzard

Commerce in the Northwest Suspended While the Newest Snow-Fighting Devices Toil in Vain

A terrible battle with snow and cold was fought all over the Northwest Dec. 11, 12 and 13. Trains were wrecked, wires demolished, railway and electric lines rendered impassable, people frozen to death, and for a time the wheels of commerce paused. Many lives were lost in the wrecks caused by the blinding snow storm that buried the tracks before trains could reach a station. Iowa probably suffered the greatest misfortune in this respect. There thirteen lives were lost in wrecks. A train on the Chicago, Burlington & Quincy crashed into the steel girder of a bridge that spans Cedar Creek, killing five and injuring three. Two trains of the Chicago, Milwaukee & St. Paul collided near Adel, Ia., causing three deaths and injuries to a half dozen or more. Five deaths and numerous serious injuries resulted from the overturning of two engines pulling a Baltimore & Ohio train near Piedmont, Va. Several persons were hurt by the overturning of two cars at the C. & P. crossing, Cleveland, O. Elevated trains in Chicago collided because of the inability of the motorman to see the train ahead in the blinding snow. Five persons were frozen to death in Chicago, one while sleeping by a fire. Street cars were derailed and tied up. Hundreds of passengers, unable to reach their homes, were forced to spend the night in hotels, and those who had not the money begged shelter in stores and houses. Railway passengers slept all night in every depot in the city, as nearly all the trains were tied up.

It was during this terrible and widespread devastation from icy blasts and burying snow that all the latest snow fighting devices were brought into play by the different railways. But all of them proved inadequate against such fearful odds. Snow-plows themselves were often stalled, and the snow came down in such overwhelming quantities that the tracks were no sooner cleaned than they were buried again. A new device, the compressed air snow flanger, shown in the opposite page illustrations, performed valuable service before the snow became too deep. These flangers, being attached to the engine, often saved trains from being blocked and probably wrecked. Fewer disasters would probably have resulted if more engines had been thus equipped. The suddenness with which the blizzard came up and the severity with which it raged for thirty-six hours in some sections shows the wisdom of having railroad engines in the northwest equipped with every device that prepares them to battle with such emergencies.

The blizzard was probably most severe in Minnesota, where the thermometer registered 24 degrees below zero, and where fences and barns were completely buried with snow, so that sleds could be driven over them. Nebraska also experienced great loss and intense suffering. Central Wisconsin and Northern Michigan had to suspend business temporarily because of the cold and snow. In Southern Michigan everything was snowbound. Passenger trains were held up for ten hours at New Buffalo. At the Soo everything was frozen up and the car ferries were unable to move.

Weather forecasters declare the storm the severest for this season in twenty years.

A HAND TEN FEET LONG.

Towering 200 feet above the streets of Port Gibson, Miss., a giant wooden hand has pointed upward during 47 years.

Recently it became unsafe, and was taken down and replaced by another. The new hand is ten feet high and was built in Ohio and shipped to Mississippi, where its erection was finally accomplished, but at great risk to the workmen who found it very difficult to handle. It is made of the heaviest sheet zinc, and is expected to endure for 100 years.

The first turbine steamer in Canadian waters of the Great Lakes is building for the Lake Ontario S. S. Co. It will be 260 feet long with a capacity of 1,500 passengers.

Popular Mechanics

"Written So You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.

JOURNAL BUILDING, CHICAGO

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00

Foreign Countries, post paid, - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS

JOURNAL BUILDING, : : : CHICAGO

LONG DISTANCE TELEPHONE MAIN 2682

Entered at Chicago Postoffice as mail matter of the Second Class

This Issue 50,000 Copies

POPULAR MECHANICS PATENT BUREAU.

Are you an inventor?

Do you want a patent, or reliable advice as to the desirability of taking out a patent?

Would you like a research made in the Patent Office of the United States or any other country in which you can take out a patent? Do you want to patent your invention in foreign lands?

Do you want to know if your patent is being infringed, and if so to prosecute the infringers and secure the damages and royalties to which you are entitled?

If your answer is "yes" to any of the foregoing questions you will be interested to know more about the Popular Mechanics Patent Bureau. This bureau is fully organized and in charge of one of the most competent patent attorneys in the United States. Before taking charge of this bureau he had many years experience in patent work in Washington covering the widest possible range of work. The Bureau has on its staff as active or consulting experts, men abundantly qualified to advise on every branch of patent work. Its aim is to render absolutely reliable advice and secure patents which when issued will be worth having. Fees for any class of service are very reasonable, and as a rule much lower than can be furnished by individuals for the same quality and amount of work.

All branches of patent work are handled and special facilities are provided for making researches in the archives of American and foreign patent offices.

While the Bureau is fully prepared to prosecute infringements, it recommends and has been very successful in adjusting claims of this character without resorting to the courts, as this class of litigation is usually more expensive than any other.

Patents in this and other countries are secured with the greatest promptness possible, the Bureau having connections in London, Paris, Berlin and other important cities.

The sales department undertakes the sale of patents and manufacturers desiring additional lines of practical, desirable articles are invited to state their wants. There is a constant demand by manufacturers for patents on articles which are really good and for which a demand exists, or for which a demand can be created.

INTERSTATE INDEPENDENT TELEPHONE CONVENTION.

The annual meeting of the Interstate Independent Telephone Association was held at the Auditorium Hotel, Chicago, December 8 to 10. Much interest was manifested in this convention, and one of the largest gatherings of Independent telephone men ever witnessed in this country was held.

The display of apparatus was unusually fine.

Among the exhibits which attracted especial attention, were those of the Automatic Electric Company, Chicago; Kester Electric Manufacturing Company, Chicago; the Maltby Lumber Company, Bay City, Michigan; the Illinois Electric Company, of Chicago, showing the Peirce patent construction specialties; Frank B. Cooke, Chicago; the Farr Telephone Construction Supply Company, Chicago; the Elliott Addressing Machine Company, of Boston, in charge of their Chicago manager, Mr. A. R. Baker; the Standard Telephone & Electric Company, of Madison, Wis.; the Chicago Die & Electric Company, of Chicago, and the Chicago Writing Machine Company, of Chicago, whose gold adjustaphone was one of the handsomest things shown. It is to be presented to President Roosevelt.

The electric roads of the United States last year carried three times the population of the earth.

Popular Mechanics' "written so you can understand it."

Electric Power in the Tropics

SOUTH AMERICAN ELECTRIC POWER PLANT

This installation consists of two Pelton Wheels of 400 horse-power each, driving two 250 K. W. electric generators at 200 revolutions per minute. The wheels operate under a head of 275 feet, the water being supplied through 30-inch pipe 775 feet long. The power is transmitted several miles and used in mining operations.

The illustration is of interest, showing clearly the complete pipe system, from masonry settling tank at the top of the line to the power-house. Also is shown the water overflowing the spillway, which is arranged at the end of the canal and near the top of the line. The pipe line is supported on a series of masonry piers. which are carried down far enough to secure a good foundation.

TO ALLOY WITH PHOSPHOROUS.

A method of introducing phosphorous into molten metals has been recommended by Mr. Edwin S. Sperry in the Aluminum World. It is to first coat the phosphorous with copper by immersion in copper sulphate solution. If properly plated the phosphorous sticks can then be handled with perfect impunity; in fact a piece of phosphorous so coppered was laid by Mr. Sperry for several hours in a mid-day August sun without ignition having taken place. Although phosphorous when copper plated is perfectly suitable for alloying just as it stands, it is, nevertheless, better first to make a rich phosphor-alloy and use the latter as the medium for adding phosphorous.

WHAT THE MUSICIAN SEES.

At the conference of musicians, in Dublin, Ireland, it was shown that a pianist has to cultivate the eye to see about 1,500 signs in one minute, the fingers to make about 2,000 movements, and the brain to receive and understand separately the 1,500 signs while it issues 2,000 orders. In playing Weber's "Moto Perpetuo," says the American Inventor, a pianist has to read 4,541 notes in a little under four minutes. This is about 19 per second; but the eye can receive only about 10 consecutive impressions per second. so that it is evident that in very rapid music a player does not see every note singly, but in groups, probably a bar or more at one vision.

Lifting a Locomotive from Niagara River

Lifts a Wrecked Train From Niagara River

Most Astounding Feat Performed by Wrecking Crane at Niagara Falls

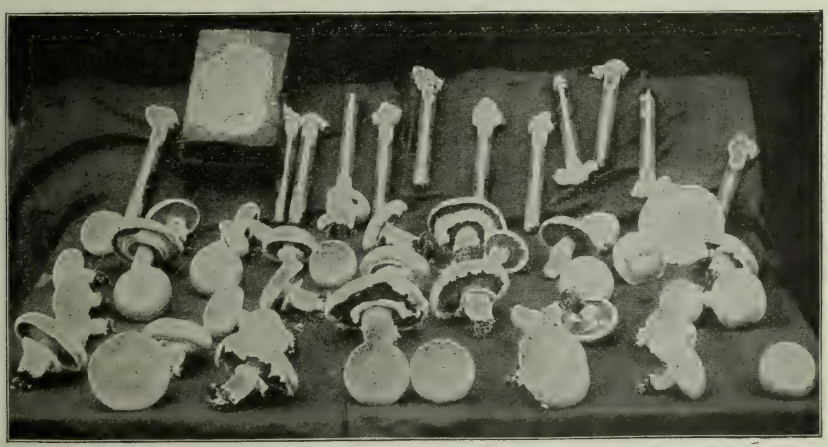
The wrecking crane, described in the November issue of Popular Mechanics, was recently called on to lift a locomotive and cars from Niagara river into which they had plunged headlong from the dock of the Niagara Falls Power Company at Niagara Falls. The wrecking crew of the New York Central Railroad with a powerful steam crane was hurried to the scene. The engine was first rescued, and the photograph from which the accompanying illustration is produced was taken during the process. Chains were placed about the sunken engine and the crane force applied. Slowly the monster on the dock raised the wrecked locomotive and then swung it upon the track.

Many people witnessed the remarkable spectacle, it being the first locomotive to sink in Niagara river and ever do service again. The engine is now at work as usual none the worse for its sensational experience. The cars in turn were lifted out by the wrecking crane and all with some repairing were able to resume their accustomed duties. This is the most significant instance on record to demonstrate the efficiency of machinery of today.

Gardens One Hundred Feet Under a Great City

Ancient Caves Beneath the Town Are Put to Profitable Purpose

St. Paul, Minn., is rapidly acquiring fame as the "Mushroom City." More mushrooms are shipped from St. Paul every year than from any other city in all the Americas. Mushrooms are shipped from there every month in the year, a distinction that no other city can claim. Besides, St. Paul mushrooms are attaining renown for their exceedingly pleasing flavor, leading epicures preferring them to the imported.



Various Stages in the Use of Pure Culture Mushrooms in St. Paul

Underneath the city of St. Paul are many great caves dug there years ago by a wealthy brewer who expected to realize fabulous wealth in using them to store and age beer. The mechanical process of aging beer, now generally in use, was invented just after he had completed the herculean task and hence his labors were all in vain.

Therefore the great subterranean vaults were abandoned and were allowed to lie idle until recently, when a man who understood the growing of mushrooms saw in them another chance of wealth. His scheme was a success, and now nearly all of St.

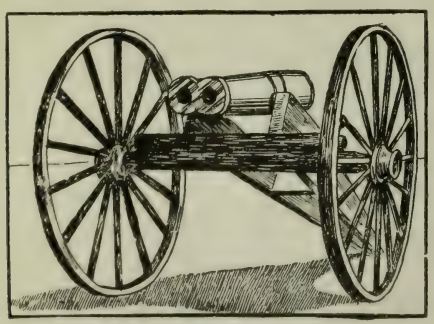
Paul's caves are filled with grown and growing mushrooms.

These caves, which are under the business district, are dug in the sandstone that underlies the entire city of St. Paul. The sandstone pulverizes on being exposed to the elements, but protected by the earth's surface it is as enduring as the hardest rock. The caverns consist in groups of passages, ranging in width from eight to twelve feet, in length from 50 to 300 feet, and are from 6 to 10 feet high. Ventilation holes from the side or top are put in at convenient intervals so that the proper supply of pure air is maintained in all parts of the cave. The caves are at the foot of cliffs which are 150 feet high, very steep, and form a natural wall along the bank of the Mississippi.

The Florists' Review says: The preparation of the beds, the planting of the spawn, the watering, etc., all receive careful attention. After the beds heat and become properly decomposed the spawn is planted at distances of 12 to 15 inches each way, and in four or five weeks after planting the mushrooms appear. Each bed lasts about three months, so that four crops can be gathered each year. During the winter months the caves are heated by stoves to maintain the proper temperature.

JOHN GILLELAND'S DOUBLE-BARRELLED CANNON.

There is now in Athens, Ga., a relic of the war, the queerest cannon ever built. It is known as John Gilleland's double-barrelled cannon. John was a smith. He devised a



The Queerest Cannon Ever Built

machine for the annihilation of Yankees. It consisted of two barrels upon a single carriage. The balls were chained together from the muzzle of one barrel to the muzzle of the other. "She's all ready, gentlemen; come out and see me fire her maiden shot," John said to his friends. They went out. The double-barrelled gun was loaded. "See that clump of timber? Watch me cut it into stove wood," said John. Boom! Swish-h-h! Bim!

John's friends rushed out and picked him up. He had lost an arm. Only one barrel had gone off at the time appointed for both of them to go, and the chain had jerked the flying missile around and sent it exactly in the opposite direction to that expected by the inventor. The gun was retired.

SMELTING IRON BY ELECTRICITY.

Electrotechnische Anzeiger, of Germany, says: "In smelting iron electrically, a plant for which has been installed at Darfo, north of Lake d'Isco, in upper Italy, the metal is reduced direct from the ore by carbon under the heat of an electric arc formed above the mass of mixed ore and carbon. Impurities are dispelled by the use of suitable fluxes. The furnace used is of fire brick and measures 40 inches square. The electrodes consist of two massive carbons protruding through opposite walls of the furnace. The distance between the two is adjustable. At the outset the arc is short, but as the furnace warms up the carbons are separated. The current used is of 2,000 amperes at 170 volts, and is obtained from dynamos driven by turbines. Using as raw material a very pure ore analyzing over 93 per cent of sesquioxide of iron, a capital steel was produced almost completely free from silicon and containing only traces of sulphur and phosphorus. The energy taken is 3,364 horsepower hours per ton of steel, and under favorable conditions it is estimated that the total cost will not exceed $18.60 per ton. The method is considered by Dr. Goldschmidt to be practicable in countries provided by nature with ample water power and pure ores of iron."

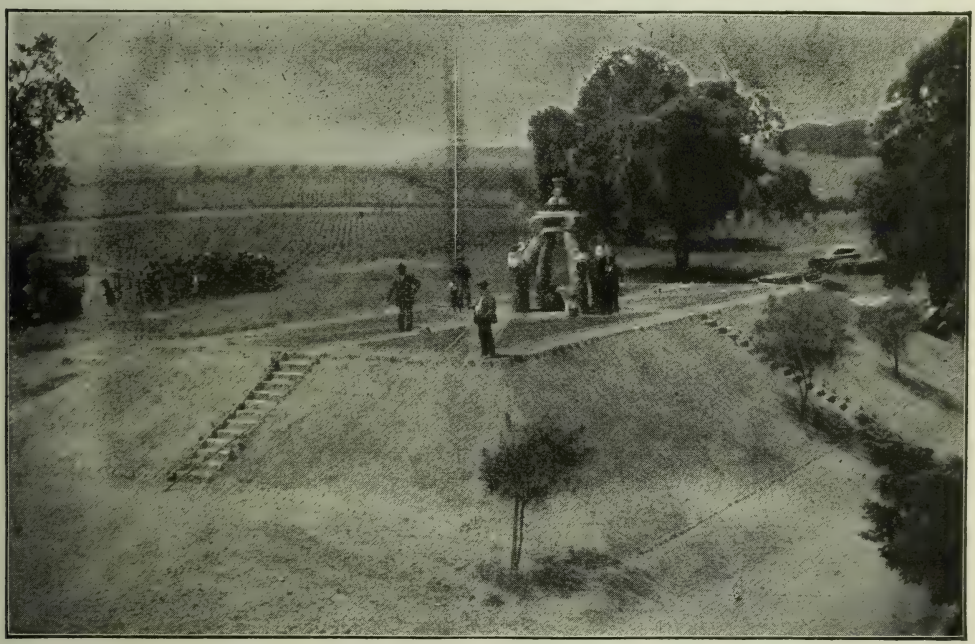
"A foundry—be it iron or brass—of any large establishment is almost always looked upon and treated as the necessary evil of the concern. In designing a new foundry an expert ought to be consulted, but not, as is generally the case, brought in at the eleventh hour, when all the plant is laid down and the foundry ready for starting work."

Alarm watches, costing $4, are now being imported from Germany.

Society Dances in a Wine Tank

Largest Vat in the World Emptied of Its Half Million Gallons and Transformed Into a Ball Room

Dancing the cotillion in a wine vat dug from the solid rock is a novelty recently enjoyed by society people of California. Los Angeles and San Francisco's smartest sets, the women gowned in decollete costumes that would have honored the Metropolitan Grand Opera, danced and promenaded on the subterranean floor of the wine vault to exhilarating music furnished by the California Military Band. Walls of the great tank were decorated with silken emblems of many hues. Brilliant electric illuminations made the underground ballroom, that had a short time before been emptied of its 500,000 gallons of wine, glow like a palace in fairyland. One hundred couples danced at one time, while many more looked on.



Largest Wine Vat in the World

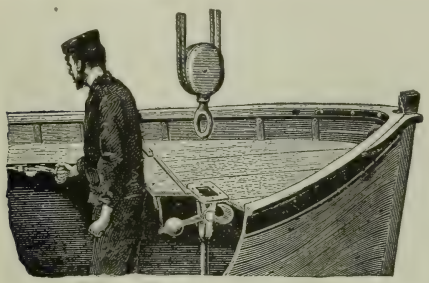
The occasion was an invitation ball given in the wine tank of the Asti vineyard on the California Northwestern railroad near San Francisco. Special trains were run from San Francisco and Los Angeles and California's society leaders, including leading business and professional men, were in attendance. The tank in which the dance was held may be regarded as one of the wonders of the mechanical world. It is the largest wine tank ever built, being about ten times the size of the tun of Heidelberg, famed by writers and tourists. It was carved out of a hill of solid stone. A layer of concrete two feet thick was placed over the sides, bottom and top. In this work 1,000 barrels of cement were used, and 6,000 barrels of gravel and fine sand brought from the bed of the Russian river adjoining the Swiss-Agricultural colony on which the vineyard is located.

The tank is 80 feet long, 34 feet wide and 24 feet deep. In preparing the vat for the dancers it was emptied of its half million gallons of wine through a tunnel 200 feet long, extending from the bottom and connecting with the winery. The emptying process consumed 4½ days. Then the vault was thoroughly scrubbed. To refill the tank, after the dancers had gone, required the constant operation of two large pumps for seven days. An idea of the immense quantity of wine stored in the tank may be obtained when it is remembered

that it would fill 250 cars, or would require 25 trains of 10 cars each to haul it. There are 50 other great wine vats at the winery, each of which is 55 feet in circumference and 20 feet high.

ENGLISH IMPROVEMENT IN LIFE BOATS.

When a life boat is being hastily lowered from a ship it is often dashed to pieces against the vessel because the sailors are unable to disengage the lowering tackle quickly enough. To prevent accidents of this kind an English sailor has invented the device shown in the illustration. Handles are placed in the life boat, any one of which



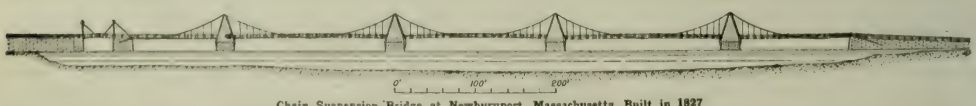
Life Boat Release

on being pulled will release the tackle provided the boat is in the water.

Commander Ingleman, of the Swedish navy, says: I observed during the short interval of 1 minute 10 seconds the boat which was previously lashed in its chocks, with turned-in davits, was lowered into the water and disengaged from the lower blocks.

CHAIN SUSPENSION BRIDGE.

A chain suspension bridge, 1,000 ft. long, supported on four towers, was a remarkable feat of engineering in 1826 when it was built across the Merrimac river at Newburyport, Mass. Each span was 200 ft. long, and a bascule draw was arranged at one end for the passage of vessels. The chains each had a breaking strength of 20 tons. The

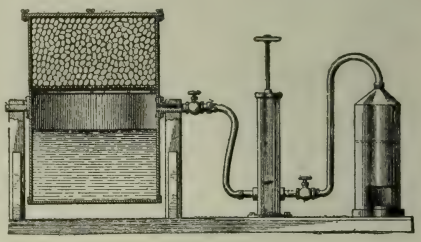


Chain Suspension Bridge at Newburyport, Massachusetts, Built in 1827

bridge cost $70,000, and was taken down 13 years later, when purchased by a railroad company which built a new bridge using the old piers. In the Railroad Gazette will be found full details.

EGG PRESERVING MACHINE.

An unusual method of preserving eggs has been patented by a man in Oregon. The cut will help explain how it is done. The eggs



Egg Preserving Machine

are placed in the upper half of an air-tight barrel, from which the air is then exhausted. The vacuum thus formed is supposed to draw through the shells any air in the body of the egg. The barrel is then inverted and a liquid preparation pours down, filling the pores of the shell. The eggs are dried in the open air and then given a moisture-proof coating of shellac and alcohol.

ELECTRC CANAL HAULAGE.

The "Zeitschrift fur Elektrotechnik," of Berlin says: "The system of electric haulage on canals in general use consists in running an automotor on the path along the canal. This requires a very good path and is expensive in the cost of road construction and maintenance. In addition there are unavoidable vibrations of the engine. With two rails the roadbed construction is less expensive, but the adhesion is not sufficient for dragging heavy boats. Still greater economy in roadbed construction is effected if a single rail be used, but there still remains the adhesion difficulty. An idea of Fabre seems to overcome the difficulty by employing two axle pairs, inclined against one another, instead of the usual two wheel axles, each with two vertical axes. A wheel is mounted on each axle, and each pair of two wheels grips the single rail. The engine is supported by one broad lateral wheel which runs on the road, the object aimed at being to increase the adhesion and stability of the engine.

The Age of the Turbine Has Come

New Motive Force is Rapidly Supplanting the Reciprocating Engine for Marine Transportation

That erstwhile great machine, commonly known as the steam engine, which has probably done more than any device of man's invention in the advancement of commerce, is fastly outliving its usefulness for marine propulsion and must soon surrender to a newer, smaller yet more powerful motivity. The turbine will soon be the newly crowned king of marine motive force. Its province is rapidly broadening to include many fields formerly occupied by the old style steam engine.

Soon a turbine equipped steamer is to cross the Atlantic; in England they are being planned for steamers for cross-channel service; the Union Steamship company of New Zealand has ordered a large turbine-propelled steamer to ply between Australia and New Zealand; the Allan line will place a 12,000-ton turbine steamer in service between Liverpool and Canada; the Cunard company is now considering the advisability of equipping their two leviathans with turbine engines, with the prospects that the reciprocating engines on both will be abandoned. A turbine passenger steamer will go into service on Lake Ontario next summer.

The manufacturer who does not foresee the coming revolution in motive force will suffer for his stupidity and awaken from his stupor to find a new era of things about him while he still saunters in the past. The world's leading mechanical authorities are beginning to realize this fact and from across the seas we are hearing words of admonition against dangers of not heeding the warning. The London Mechanical Review, which voices the opinion of Europe's leading journals, says: Fresh evidence is being supplied almost daily that not only for small craft but for large sea-going vessels where high speed and comfort are desirable, the turbine is becoming the favorite motor. There are many good reasons for the preference. The turbine propels at higher speed with greater economy of fuel. In other words, the compound turbine imparts more power to the screw propeller from a given quantity of steam than has ever been obtained from the older form of engine. And while it is not more costly to install, even now, it is considerably lighter, occupies much less engine room space, and, therefore, allows more room for cargo and passengers. It tends to greater stability in the vessel owing to its low center of gravity, and this means that in warships the propelling machinery will be better protected from the irruption of shot or shell, for it can easily be well below the water line. Perhaps the most noticeable point in favor of the turbine is the extreme simplicity of its construction. The only wearing parts are the bearings. This means easy lubrication and less trouble in repairs. Then again, the knocking and vibration which are inseparable from reciprocating engines in which the momentum of moving parts is constantly reversed, must be almost entirely absent in the rotary engine, the balance of which is so perfect. There can be no tremor or shock except what little may result occasionally from the action of the screw propeller in a turbulent sea.

BOY BUILDS MOTOR CAR.

Starting with a soap box for material, a San Francisco boy of 16 has built an "automobile" which will travel nearly 10 miles

Soap Box Auto, San Francisco

an hour. Six months were spent in the building. He made the patterns himself and had the castings made in a foundry, then

finished them up. A friend forged the crank shaft. The Motor Age says:

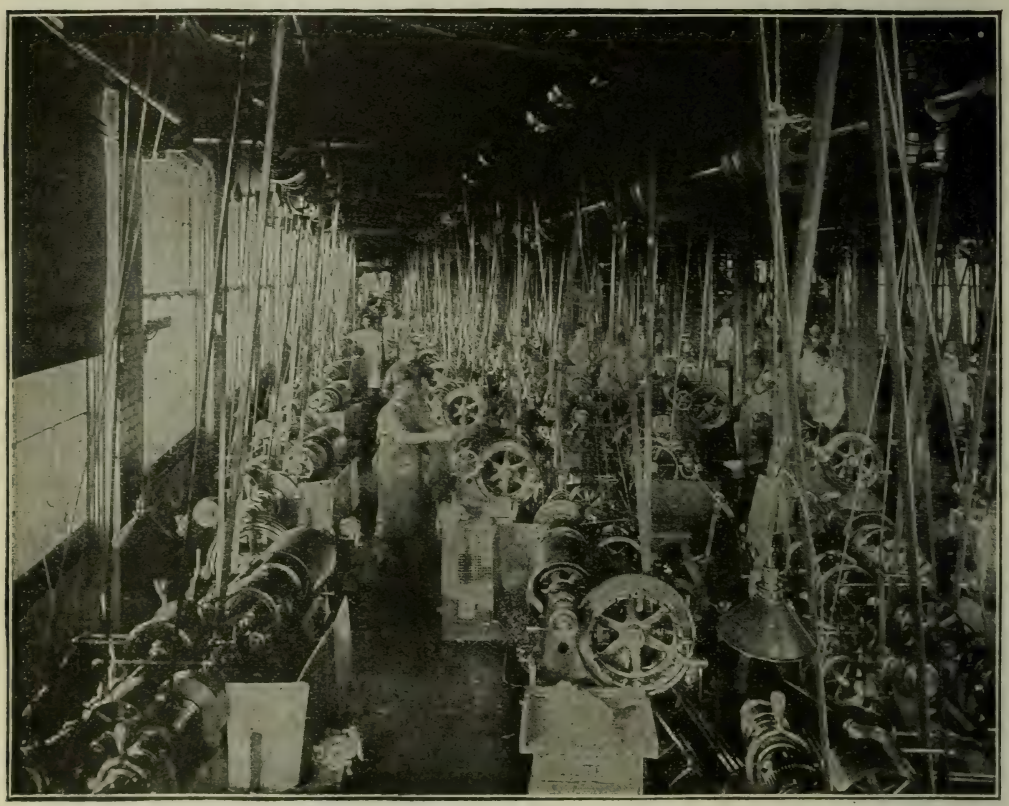
"The frame of the vehicle is made from two pieces of oak attached to two axles. The rear axle is solid with two wheelbarrow wheels and babbitt bearings. The front axle turns on a king bolt, buggy style. The steering gear is an ordinary pair of bicycle handle bars. The seat is 2 feet high, necessitating steering by the feet on the handle bars. From the seat the clutch and air valve are operated. The engine is vertical under the seat, and the gasoline tank serves as surface carbureter. A rubber hose connects the tank with the motor. Air enters the tank through a hole, and in passing over the fuel picks up a charge."

The first steam warship ever constructed by any nation was built and launched at the Brooklyn Navy Yard. It was the frigate Fulton, a 30-gun vessel of 2,000 tons, built in 1815.

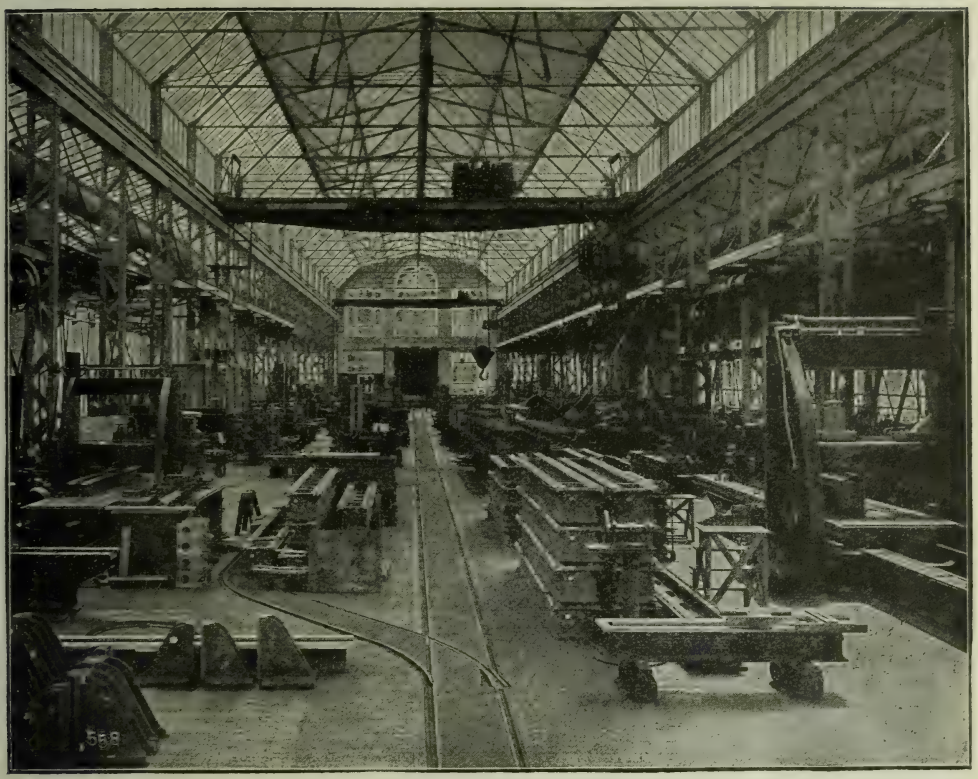
MACHINE SHOP WITHOUT SHAFTS OR BELTS.

Electric Motors on Each Machine Effect Great Saving

Instead of miles of expensive belts filling the air with dust, and tons of costly shafting and pulleys, the modern machine shop has a small electric motor to drive each machine. Electric current to supply these motors may be bought from some power company, or made in the works by a large generator driven by a steam engine. In place of the great mass of overhead shafting, which shuts out light and requires extra heavy timber construction to sustain it, a few wires, scarcely noticeable, transmit the power with only a small fraction of the loss. In every belt driven shop may be seen scores of belts moving rapidly, being worn out and using up power, but doing nothing because the machine to which they



The Old Way.
An example of a great investment in shafts, pulleys and belts, causing a loss of power in transmission amounting to over sixty per cent.



The New Way.

Electrically Driven. No belts, shafting or pulleys, Allows a clear headway for crane service;a more convenient and economical arrangement of machines, and better lighting-

belong is not in use. With the electric motor, no power is used unless there is use for the machine it drives. The illustrations furnish a striking comparison of the belt-driven and motor-driven shop.

HUGE CONDUITS FOR WATER POWER.

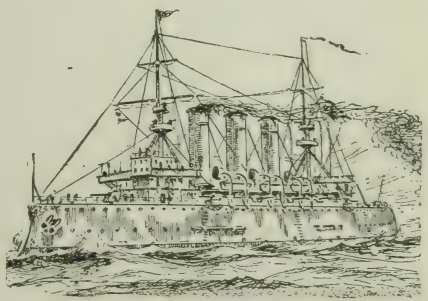
Twelve feet in diameter or large enough for a horse and cart to drive through are the enormous conduits being built in France in the work of harnessing the streams for water power. So valuable has become this water power in France that there it has been dubbed "White Coal." One-half million horsepower has already been obtained from the streams of France, and more plants are being built every day.

A WATER PIPE USED IN FRANCE.

In utilizing the water power it is necessary to construct conduits large enough and strong enough to conduct water forced through at a very high pressure without bursting the conduit. They are made of steel or cement strengthened with iron bands, and are furnished with safety valves in case of emergencies.

TURKEY HAS NEW CRUISER.

Any addition to the Turkish navy is a great event—for the Turks. "Abdul Hamid"



Cruiser Abdul Hamid

is the latest, a small cruiser 340 feet long, 47 feet 6 inches beam.

Golden Spike Completes the Cutoff

Natural Oppositions Seemingly Defied in Building a Railroad Across Great Salt Lake

FACTS ABOUT THE OGDEN-LUCIN "CUT-OFF."	
Original road	146.68 miles
New road	102.91 miles
New road saves	43.77 miles
New road saves 3,919 degrees curvature.	
New road saves 1,515 feet vertical grade.	
Annual saving in operating expenses	$500,000
Permanent trestle built in Great Salt Lake	11.10 miles
Temporary trestle built	11.84 miles
Distance between the east shore and Promontory Point	8.03 miles
Distance between the west shore and Promontory Point	19.45 miles
The permanent trestle is nearly all in water from 30 to 34 feet deep at the present level of the lake.	

constructors are being hailed as men of wondrous genius and foresight. Railroad men laud the courage displayed by Mr. Harriman in risking the undertaking and J. Kruttschnitt, William Hood, Horace C. Burt and J. B. Berry, officials of the Union and Southern Pacific are praised for advising its undertaking.

The completion of the Ogden-Lucin cutoff was memoralized by the driving of a spike of solid gold by E. H. Harriman. H.

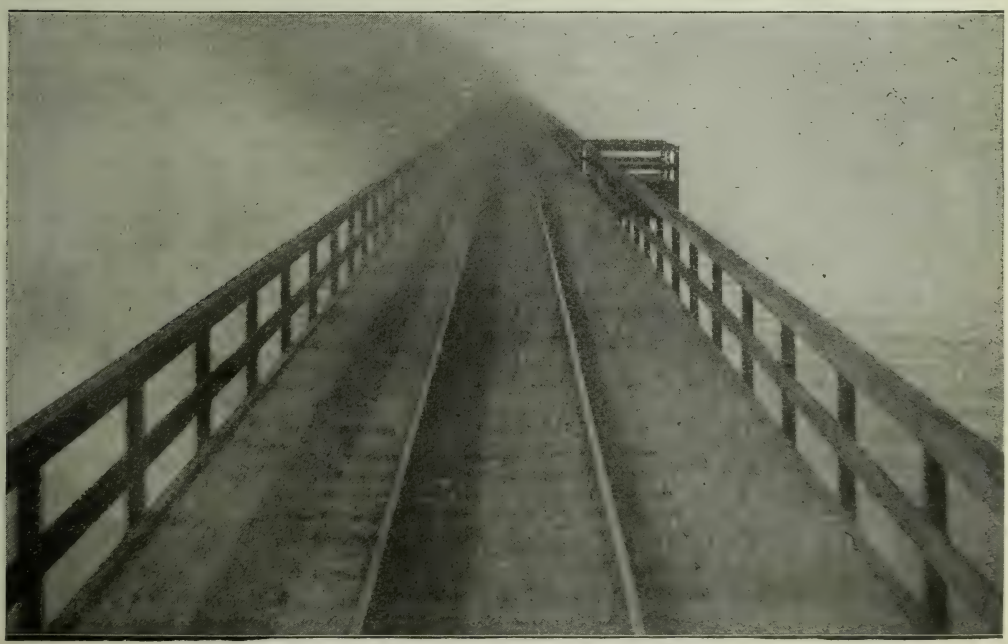
Ogden-Lucin Cutoff Through Great Salt Lake—Permanent Trestle

It seems that the science of civil engineering has advanced so greatly that nature can no longer successfully oppose obstacles to the construction of railroads. When Collis P. Huntington first thought of going through mysterious Salt Lake instead of around its northern end, he was regarded as a dreamer. When Edward H. Harriman actually undertook to do the thing at an expense of nearly $5,000,000 he was thought to be courting ruin. The western press ironically referred to Mr. Harriman's "great sink hole," into which he was said to be pouring millions that would never bear fruit. But now that the Ogden-Lucin cutoff is an accomplished fact, its advisors and R. McCullough, third vice-president of the Northwestern railway says the opening of the Ogden-Lucin cutoff was more historical than the union of the east and the west when the golden spike was driven into the Southern Pacific track on Promontory Point, May 9, 1869. He said: "It represents the limit of development in transportation methods contrasted with the journey of old Jim Bridger when he discovered the great Salt Lake and the Bear river in 1824. Since then the expenditure of many millions has reduced the time to three days, and finally the elimination of the summit of Sherman Pass by the Aspen tunnel, the conquering of Salt Lake, the reduction of grades and the elimination of curves, and the double tracking of the Northwestern, all at an ex-

Building the Cutoff—Men Working on Rafts, "Where Everything Floats."

pense of more than $60,000,000, have made possible the further reduction to two and one-half days or two days from the Missouri river as against sixty days by the overland stage of fifty-three years ago.'

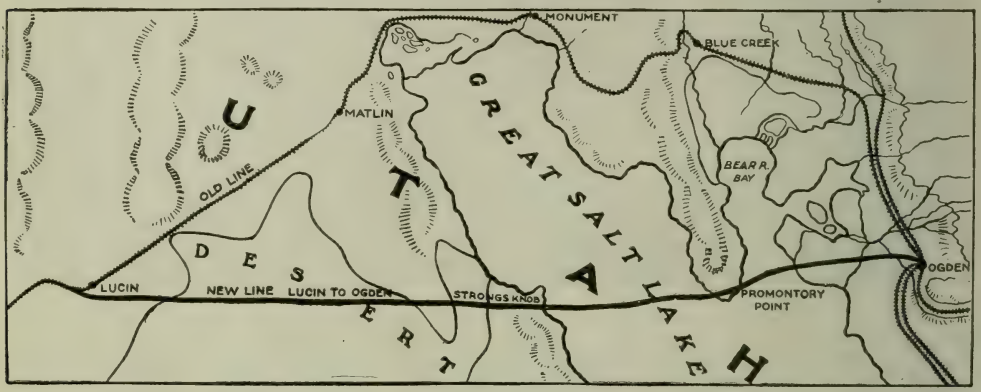
The Ogden-Lucin cutoff runs 72 miles on land and over 30 miles on the trestle-work and fill-ins over the waters of the Great Salt Lake. The use of the cutoff will throw out of transcontinental traffic the old line from Ogden to Lucin, Nev., around the north end of Great Salt Lake. This stretch of



Permanent Trestle and Roadbed Over Great Salt Lake

track, nearly 147 miles long, is one of the most difficult and expensive of the Harriman system. Its maximum grade over the long promontory hill is 104 feet to the mile and helper engines are required to handle trains. The elimination of this trackage from overland traffic will thus mean a saving of more than $1,500 a day, in the actual operating and also a saving of two hours in running time.

The cutoff runs from Ogden west for fifteen miles over level country before reaching the lake shore, then crosses the east arm of the lake, a width of nine miles, to Promontory point; then nineteen miles across the west arm of the lake; thence across the Great Salt Lake desert to Lucin, Nev. Across the east arm of the lake will be an almost continuous fill-in supporting the trestle. Near the middle of this will be a gap of 600 feet of open trestlework, left for the waters of the Bear river, which flows into this arm of the lake.



Map of the New and Old Lines Showing the Distance Saved

Across Promontory point runs five miles of solid roadbed, and here difficult work was encountered, a cutoff of 300 feet in length in sand and rock of abrupt bluff being necessary. On this point, one of the most picturesque around the inland sea, a station will be maintained, and surveys have been made for a mammoth summer resort. Across the west arm of the lake is a stretch of eleven miles of trestlework, with a fillin approach at each end.

In accomplishing the work of spanning the lake, one great difficulty was encountered across the east arm, in the "sinks" or settling of the fillins and trestlework. This was caused by the salt from the flow of Bear river having collected for centuries over the bottom of the lake and formed an insecure foundation for a depth of nearly a hundred feet. It took thousands of tons of rock and piles without number to reach bottom proper, but this was finally accomplished, and the gradual spreading out and packing of the fill has resulted in a firm roadbed.

RUBBER AND ITS SUBSTITUTES.

Over 100 million dollars worth of manufactures from India rubber are now turned out from the factories of the United States every year, and about half this total is in the form of boots and shoes. The industry of importing and reclaiming India rubber for re-use in manufacturing is, comparatively, a new one, and while it utilizes large quantities of worn-out rubber, boots and shoes and other articles of this character from the scrap heaps of the United States, it has extended to other parts of the world only in recent years.

In 1893 the total importation of old and scrap India rubber fit for re-manufacture was less than a million pounds. In 1896 it was over 3 millions; in 1898, more than 9 millions; in 1900, 19 millions; in 1902, 22 millions, and in 1903, 24,659,394 pounds, valued at $1,516,137.

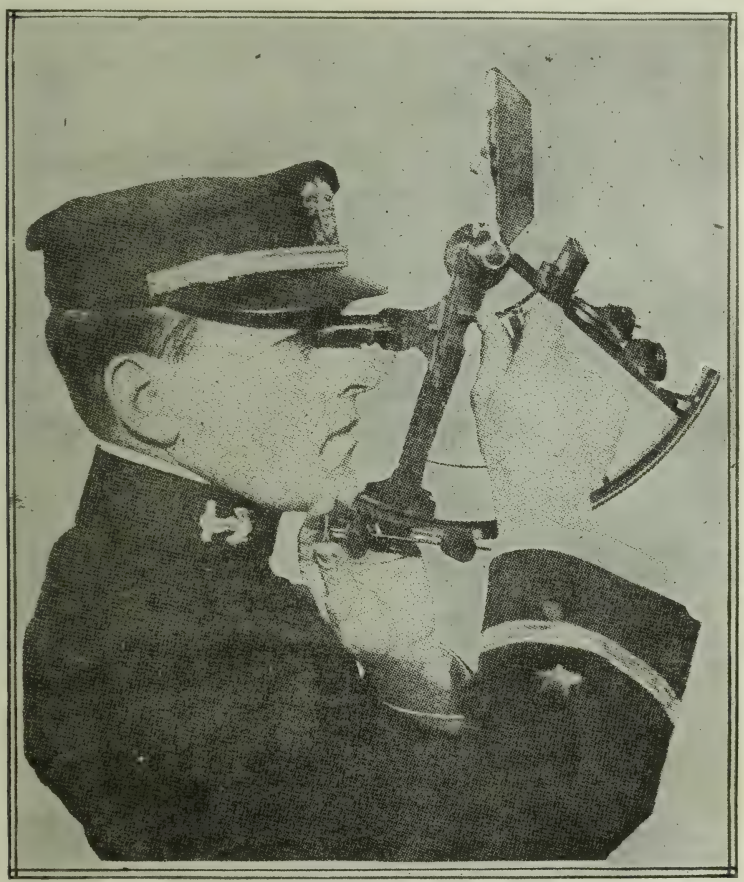
Gutta-joolatong is another comparatively new material which may be utilized in conjunction with India rubber. It is a product of the East Indies, chiefly the Island of Borneo, located not far from the Philippines. In the form in which it is imported it is of a whitish color, looking something like marshmallow candy, smelling strongly of petroleum and oxidizing on exposure to the air, becoming hard. It is not a substitute for gutta percha or India rubber, but is used chiefly as a filler in manufactures of India-rubber gum and gutta percha.

Prism for Measuring the Actual Dip of the Horizon

If you should ask the navigating officer of a great ocean liner or battleship when at sea what was the most important thing to him, next to his compass, he would answer, "To know where we are."

To determine this fact every vessel is equipped with charts showing all the harbor entrances, signal lights, sunken rocks, reefs, islands, etc. When once out of sight of land calculations can no longer be made from lights and shore land marks, and an instrument, the sextant, is employed.

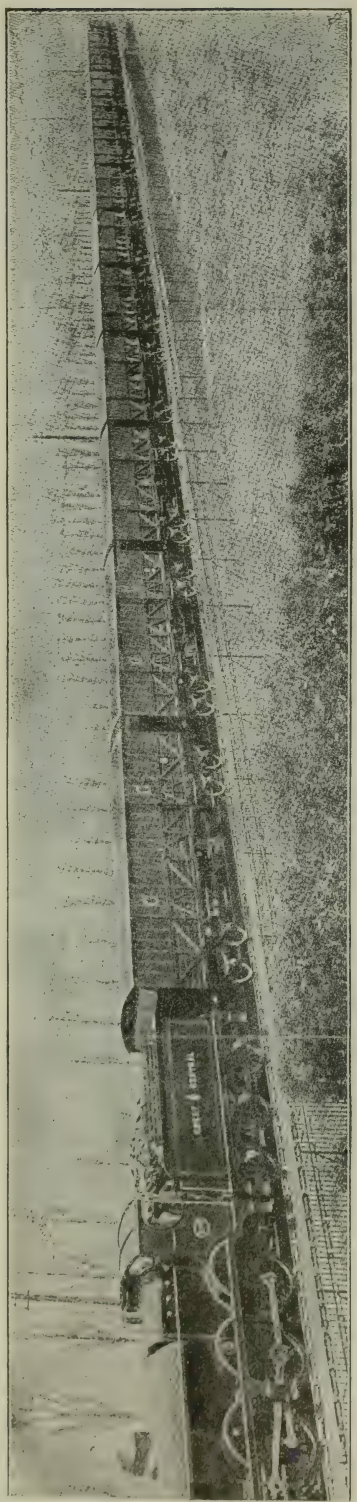
In order to secure reliable data, however, a clear atmosphere is necessary. Even then mistakes are frequent, and the navigator suddenly finds himself many miles out of the supposed course. When the cable steamer Farraday was laying a cable from Nova Scotia to the Azores three years ago, nine expert navigators were busy taking sights from earliest dawn to dark. One bright day all observations were found to be wrong, and after several hours' corrections were secured it was found the ship had been sailing three miles out of the intended course. The mistake was caused by a change in the atmosphere which had raised the apparent horizon above normal.



Measuring the Actual Dip of the Horizon

One of the navigators on this cruise was Commander Blish of the U. S. Navy, who has been working since that time to devise an instrument which should be absolutely correct. He believes he has succeeded by the use of a prism which is attached to the sextant.

Fish Train on the Great Central Railway of England



Nineteen Cars Each Carrying Fifteen Tons of Fish

FISH TRAINS OF ENGLAND.

Like American Cattle Trains, They Make Fast Time and are Composed of Special Cars

Fish trains are becoming as common in England as are cattle trains in America. The innovation was started by the Great Central Railway, which has an enormous volume of fish traffic from the coast. A typical fish train on this line is shown in the illustration. Special cars are used exclusively for this kind of traffic. The cars are handled in complete trains by ten-wheel engines on a fast schedule. The train illustrated is made up of 19 cars carrying 15 tons each, each car weighing 19 tons when not loaded.

The Railway Review says: "The floors of the cars are cemented, and the loads arranged to make the run from Grimsby Docks to Marylebone, a distance of 223 miles, to be made in about seven hours, including the time occupied in distributing portions of the load along the road."

ANOTHER NORTH CAROLINA MILL.

North Carolina seems to be the home of the odd and antiquated water mill. One of them was shown in a recent issue of Popular Mechanics. Here is another—a grist mill, which was imitated by Illinois in pioneer days. The mill was constructed near a spring that flowed over a bluff. A heavy post was set up with a natural fork at its top. Across this fork a beam extended, on one end of which a box was constructed, and from the other end of which a boulder was suspended over a mortar hollowed out from the stump of a tree. As the box filled with water it descended and raised the boulder-pestle. When the box descended the water ran out and the empty or partially empty box, overbalanced by the boulder, rose to be again filled and repeat the teetering operation. It was automatic and all the settler had to do was put his corn in the mortar, swing the box around into range of the spring by attaching the boulder and go about his business. He could put the corn in at night and find it converted into meal by morning, for, as the mill required no attendance, it worked just as well at night as any other time.

Flash New Year's Greetings Round the Globe

Naval Observatory Sends Telegraphic Time Signals and Receives Them on the Same Chronograph

The United States Naval observatory sent telegraphic time signals throughout the world to mark the beginning of the new year. The signals were sent last year for each of the four great standard time belts of the United States, but this year the observatory secured not only a wide distribution of the signals throughout North and South America, by the co-operation of the telegraph and cable companies, but also sent two of the four series of signals around the world and back to the naval observatory. The signals began at 11:55 p. m. and ended at midnight eastern time. The same series were sent out an hour later, ending at midnight central time. Again an hour later, ending at midnight mountain time, and again an hour later ending at midnight Pacific coast time. On the world circuit the signals went by land lines to Cape Causo, Nova Scotia; thence by cable to the Azores, Lisbon, Gibraltar, Malta, Alexandria and Port Said; by land to Suez; by cable to Aden and Bombay; by land to Madras; by cable to Penang, Singapore, Saigon, Hongkong, Manila, Guam, Midway, Honolulu and San Francisco and by land back to Washington. Both the outgoing and ingoing signals were received on the same chronograph at the naval observatory and thus a permanent graphic record of both were preserved on a single sheet of paper.

Besides demonstrating the possibilities of practical astronomy and telegraphy working together, through international co-operation, benefits will result from the general attention the signals directed to the advantages of using accurate standard time throughout the world. The messages also carried a New Year's greeting to the world.

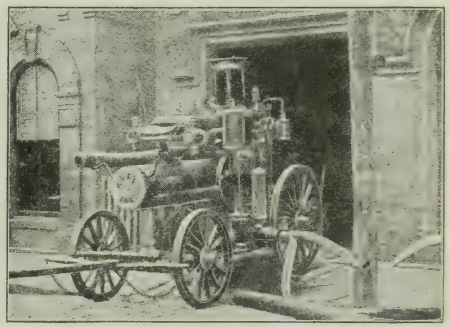
FIRE ENGINE OPERATED BY COMPRESSED AIR.

A steam fire engine was operated successfully with compressed air instead of steam at Norwich, Conn. Chief Stanton has been experimenting for some time and it is possible the entire system of operating fire engines, at least in the business districts o large cities, may be changed as a result.

For the test pipes were run from a large air compressing plant to Central Wharf, where the steamer was stationed. An air pipe 1½-inch diameter and 500 feet long conducted the air to the steamer where it was connected to the boiler. No fire, of course, was necessary and the boiler was filled with air at a pressure of 90 pounds instead of steam. When the pumps were started the machine was taking water through a supply hose 28 feet long and playing three 1⅛-inch streams 150 feet through three lines of hose. The test lasted an hour and a half. Frost formed on the cylinders, and at a distance of 100 feet the exhaust from the stack looked as much like smoke as if there were a fire in the machine.

The advantages of the compressed air are several. A great saving in weight resulting from doing away entirely with the boiler so that one horse could haul the machine. In some cities the water used for fire purposes is not of the best, and causes the boilers to foam. The compressed air fire engine could be built for one-third the cost of a steamer of equal capacity.

The plan proposed is to have a central compressing plant with pipes leading in all directions and places at frequent intervals where the fire engine could connect to the



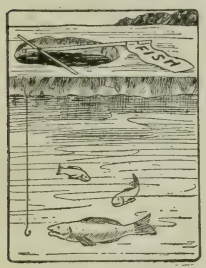
Compressed Air Fire Engine

air system. There would be no time lost in getting up steam, and no fuel to carry on the engine, while the machine itself would weigh much less than an ordinary one-horse hose cart when loaded. The Firemen's Herald says the proposed plan could not do away with the steam fire engine entirely, but might be used to very great advantage in many places.

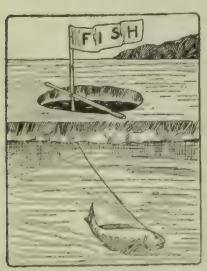
MECHANICS FOR YOUNG AMERICA

Devices of Winter Sports--How to Make and Use Them

Fishing in the south is confined to the warm season, but in the north the red-cheeked boy digs a hole in the ice and while he amuses and invigorates himself at skating, the fish underneath the icy sheet fasten themselves to the hook he has let down through a hole. The northern boy used to sit over the hole in the ice and wait for the fish to bite, but that became too slow and detracted too much from his pleasure at skating. So his inventive genius set itself to work and the "tip up" and "signal" shown in the illustration was the result. When the fish is not biting the flag lies flat on the ice, but as soon as a fish has swallowed the hook the flag pole stands straight up wafting its bright colored flag to the breezes and all the boys on the skating pond read the word "fish." The fish is drawn up, the hook rebaited and the youthful fisherman resumes his pleasures on the ice. Often a score or more of these "tip ups" are planted about the edges of the ice pond, each boy bringing his fishing tackle with his skates and thus finding a double source of amusement. Maybe one boy will thus have a half dozen different lines in the water at once, it being easy to watch them all together.



"Tip-Up" Pole

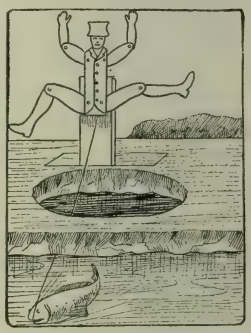


"Tip-Up" Fish Caught

The device by which the fish is made to give its own signal when caught is exceedingly simple and any boy can make it. Procure a light rod about two feet in length and to one end fasten a small flag, made of any bright colored cloth. Bind the rod at right angles to another stick which is placed across the hole, so that a short piece of the flag-rod projects over the cross stick. To this short end fasten the fishing line. Be sure and use strong string in binding the two rods together, and also take care that the cross stick is long enough to permit several inches of each end to rest on the ice. After fastening the line to the short end of the rod, bait the hook with a live minnow or other suitable bait and let it down through the hole. When the fish is hooked the flag will instantly raise and wave about strenuously until the fish is taken from the water.

"JUMPING JACK" FISHERMAN.

If the small boy has a "jumping-jack" left over from Christmas he may make this do his fishing for him and serve as well as the "tip-up," or he can easily make the jumping-jack himself independent of Santa Claus. The string which is pulled to make the joints move is tied securely to the fishing line; the hook is baited and lowered into the water through a hole in the ice. The "jumping-jack" waves his legs and arms frantically to notify the boys when the fish is biting. The "jumping-jack" is also used for fishing in summer time by placing it on a float which is cast into the water.


"Jumping Jack" Fisherman

WINTER VELOCIPEDE.

Bicycles may be converted into novel sleighs by simply overhauling. The usual bicycle frame and pedals are used, and gearing transmits to contact wheels, in which are sharp spikes for catching in the snow or ice. Instead of moving on wheels the machine is carried on runners.

THE RUNNING SLEIGH.

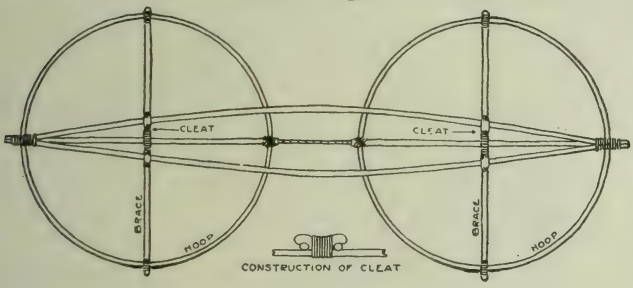
Another winter sport, very popular in Sweden last winter, and that has already reached America, is the "running sleigh," shown in the illustration. A light sleigh is equipped with long double runners and is propelled by foot power. The person using the sleigh stands with one foot upon a rest attached to one of the braces connecting the runners and propels the sleigh by pushing backward with the other foot. To

steady the body an upright support is attached to the runners. The contrivance can be used upon hard frozen ground, thin ice and snow-covered surfaces, and under favorable conditions moves with remarkable speed. The "running sleigh" has a decided advantage over skis, because the two foot supports are braced so that they cannot come apart. Any boy can make the sleigh with a little pains.

THE WINGED SKATER.

With the actual speed of the wind a skater may be hurled along the ice if he is aided by sails. He has been known to travel at the rate of 100 miles an hour, and the sport while affording the limit of excitement, is not attended with danger. The sails are easily made, as the illustrations and description will show.

Secure two large thin hoops about four feet in diameter. They may be obtained from an old hogshead or by bending thin strips. For each hoop select a piece of strong cane about three-fourths of an inch in diameter to constitute the fore and main masts or cross-yards. Extend these across the center of the hoop and fasten each end firmly to the hoop's sides. For the middle of each cross-spar make a



Skater's Sails

cleat and lash it on firmly.

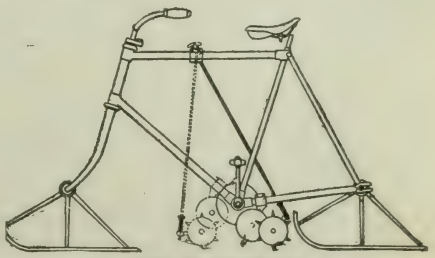
The main spar should also be made of two pieces of strong cane, each about 9½ feet long. Bind them together at each end so that the large end of one is fastened to the small end of the other.

Next comes the attaching of the sails to the separate masts. The sails should be made of strong sheeting or thin canvas. Tack the cloth to the hoop on the inner side after the cloth has been wrapped around the hoop two or three times.

Now the main spar should be attached by springing it apart and slipping the cleats of the cross-spar between the two pieces. Bind the inner sides of the hoops tightly together by means of a very strong double cord, as shown in the figure. Then your sail is ready for the ice pond. See that your skates are securely fastened, raise your sail and you will skim along the ice as lightly as a bird on the wing. With a little practice you will learn to tack and guide yourself as desired.

Running Sleigh

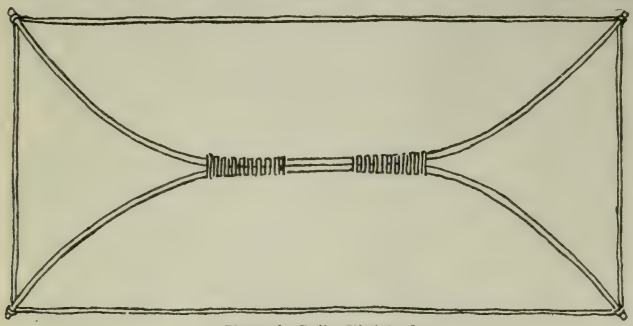
If the hoops cannot be easily obtained the sails may be made equally effective by using the main spar and fore and main masts as herein described, making the sails square shaped instead of round and leaving off the hoops. In this case the sails should be securely bound with strong tape. Attach a corner to each end of the cross-spar, and a corner to the outer end of the main spar. The remaining corner of each then appears opposite to each other, and should be fastened together by strong cord in the same manner as the hoops. In this case the sails may be left off until after the frame



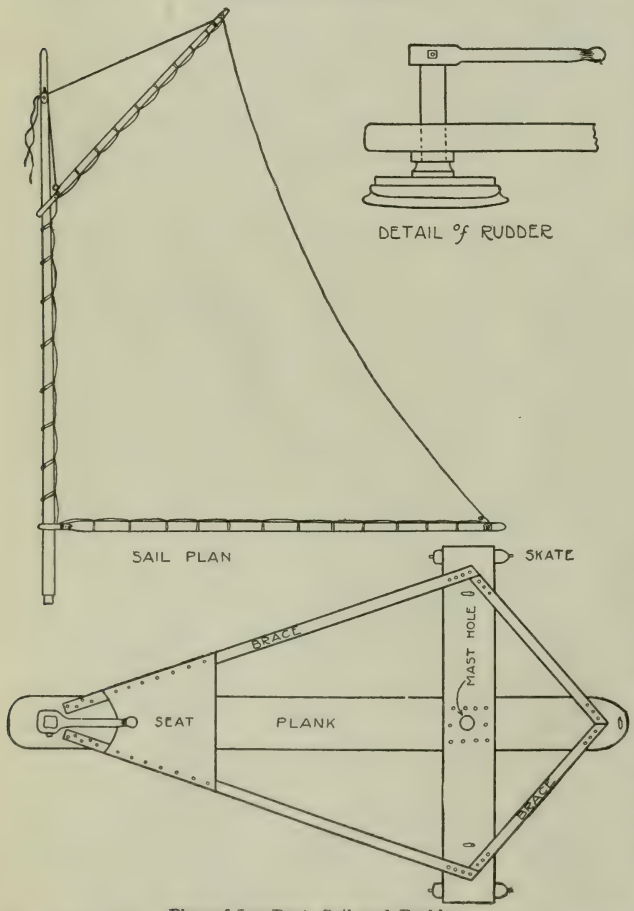
The Bicycle Sleigh

is entirely put together and then fastened on to the spars by buttons.

A more simple sail may be made according to the plans illustrated in the lower drawing. It is made by binding together in the center the halves of two strong hogshead hoops, or two bent poles are better.



Skater's Sails Finished



Plan of Ice Boat, Sail and Rudder

If possible the sail should be about eight feet long and four feet wide. Fasten on the sail at the four corners. The rig will convey two persons and is more easily constructed than any other.

ICE BOATING.

But the sport that is greatest of all, the one that used to be part of the life of every northern boy, and which is being revived in popularity after years of stagnation, is ice boating. With the aid of old skates, pieces of board and an old sheet or a small bit of canvas, any boy possessed of ordinary mechanical genius may make an ice boat. The frame of the boat should be made something in the form of a kite. The center-board should be four or five feet long, six inches wide and two inches thick. The cross board may be of a piece of 1 by 6 inch plank three feet long. Fasten these with braces of small stout strip, as shown in the drawing, and screw the cross piece securely to the center-board. Bore a hole in the center of the intersection for the mast pole. The seat may be made of a piece of strong cloth or leather. Three skates are fastened on to either

Boy's Ice Boat

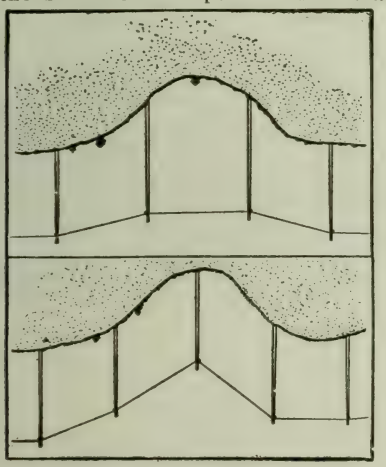
side of the cross-board and one to the rear end of the center-board, the latter of which is to operate as a rudder. In attaching the skates first make a couple of runner blocks, each six inches long and three inches wide. Bore holes in them for the straps of the skates to pass through and fasten them securely. Nail the runner blocks firmly to the cross board about 1½ inches from each end.

In making the rudder hew down a piece of scantling one foot long until is assumes the shape of a club with a flat base. Nail a strip of wood firmly to this base, and to the strip fasten the skate. Run the top of the club through a hole bored in the stern of the center-

board. Then make the helm by boring a hole in one end of a strip of soft board about one foot long, and through this hole pass the club or rudder-pole and fasten it so it may be shifted when desired. Make the sail out of an old sheet, if it be strong enough, piece of canvas, or any such substance and attach it to the mast and sprit as shown in the illustration, and guide it by a stout string attached to the lower outer corner. As an ice boat will travel faster than the wind, some care and considerable skill is necessary. Unless you are accustomed to managing a sail boat do not select a place in which to learn where there are air holes or open water. To stop the boat throw the head around into the wind, same as you would with a sail boat. If the wind is strong the occupants of the boat should lie flat on their stomachs.

GRADING A POLE LINE.

Grading a pole line is a term used by telegraph and telephone linemen. It is very much like grading a railroad—trying to secure as near a level as possible. The Telephone Journal explains the process with an illustration. The advantage of the level line is in equalizing the strain on the poles and insulators.



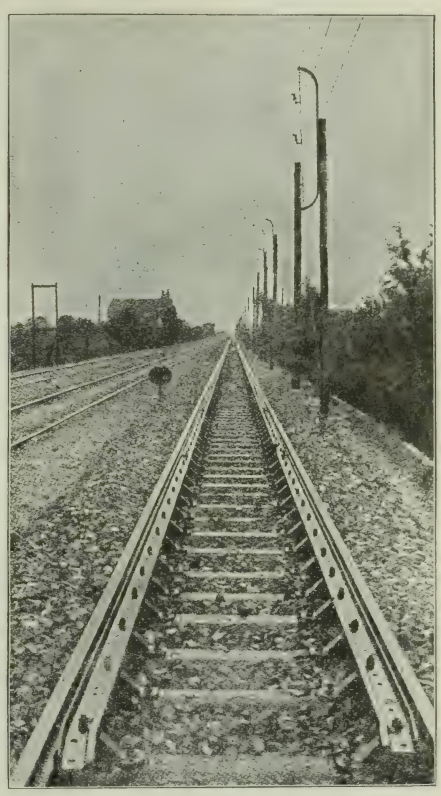
Grading a Pole Line

In the first illustration the tendency is to pull over the poles on the side of the hill, and to pull up the one at the bottom. The second cut shows how the line should be built.

Insurance against appendicitis is the latest English insurance fad. A policy costs $1.25 a year, and insures surgical treatment, not to exceed $500.

HIGHEST SPEED RAILWAY TRACK.

The remarkable world-breaking record of 130 miles an hour on the Berlin-Zossen line, described in the November issue of this magazine, was made upon the railway track



World's Record Track

shown in the accompanying illustration. In order to lessen the danger of the experiment a guard rail was laid next each main rail, on the same plan American roads employ on bridges. Instead of standing the rail in an upright position it was placed on its side with the base of the rail next the main rail. The Electrical Review says: "These guard rails were bolted to cast iron chains, which in turn were bolted to the ties."

There are three waters in the state of Indiana which actually impart magnetic powers to needles, knife blades, etc. Any considerable quantity of one of these waters will deflect the needle in a compass.

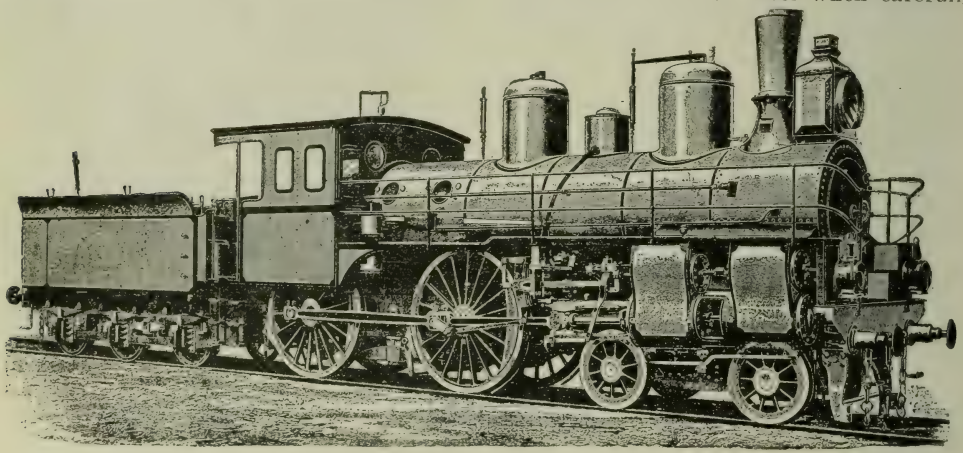
Popular Mechanics is written so you can understand it.

FROST ON SHOW WINDOWS.

As an excellent remedy against the freezing of show windows, the Pharmaceutische Zeitung, a German publication, recommends the application of a mixture consisting of 55 grams of glycerin dissolved in 1 liter of 62 per cent alcohol, containing, to improve the odor, some oil of amber. As soon as the mixture clarifies, it is rubbed over the inner surface of the glass. This treatment it is claimed, not only prevents the formation of frost, but also stops sweating.

RUSSIAN PASSENGER LOCOMOTIVE.

The standard express locomotive on the Russian Empire Railways are tandem-compounds, and make as high as 70 miles per hour on fairly level track. The illustration shows the drivers set well back and two high steam domes. The boiler plates are ⅝-in. iron plates. Steam pressure of 191 pounds is maintained. The cylinders are 14⅜ and 21½-in. diameter by 24-in. stroke. Absence of a bell, the top of smoke stack and the sawed-off appearance of the front end, peculiar to continental service, will all be noticed in the cut.



Tandem Compound Russian Express Locomotive

The telechirograph is a German invention by which one's handwriting may be transmitted by telephone wires, without the services of an expert receiver.

STEEL TUBES FOR LOCOMOTIVES.

Iron tubes are used in the locomotive boilers of almost every railroad in the United States. On the few roads here which have used the steel tubes the results have been so satisfactory that their general adoption is not unlikely. In France and some continental countries the steel tubes have been used for upwards of 10 years. Where only impure waters are obtainable the steel tubes are specially desirable. Greater care is necessary in their manufacture owing to the rapidity with which they cool when being welded. The best practice now is to reheat the tubes after welding and allow them to cool in the retort in which they are reheated. It has been claimed that steel pits more rapidly in boilers than iron, but this is by no means certain.

Professor Henry M. Howe in a paper on the relative corrosion of wrought iron and steel, said: "We have strong reason to believe that low carbon steel when carefully made resists corrosion in fresh water as well as wrought iron, and in acidulated water, better than wrought iron."

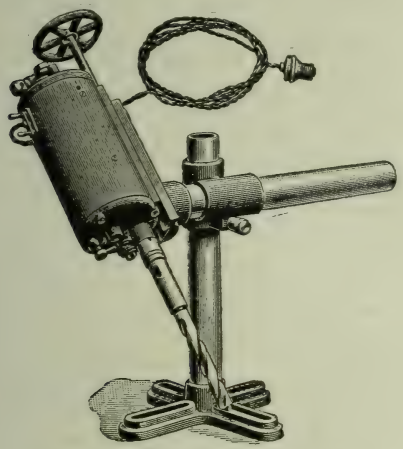
The Railway Age says: "Mechanically the steel tube is decidedly superior to the iron one. It is much stiffer and is better suited to the great lengths required in modern boilers. The bursting strength of steel tubes is much greater than that of iron tubes, and the tensile strength 25 to 30 per cent greater."

Out of the great overflowing abundance of printed matter about mechanics is gleaned the helpful, the clean, the instructive, all the rest is discarded; the essence of the gleanings is gathered and concreted, and the result is called Popular Mechanics. Its success attests its merits. Some people say Popular Mechanics is the best magazine published.

SHOP NOTES

PORTABLE ELECTRIC "SCOTCH" DRILL.

A handy machine recently patented is a Scotch drill operated by electricity. It can be used in any shop having incandescent electric lights by connecting to the nearest socket. It will drill up to ⅞-inch diameter



Electrically-driven "Scotch" Drill.

and has a feed of 7 inches, controlled by the hand wheel. It is mounted on a pedestal which admits of movement in any direction. The machine is 30 inches high and weighs less than 100 pounds.

LEATHER BELTS.

A leather belt is more economical in the end than a rubber one. When buying a leather belt it should be tested by doubling it up with the hair side out; if it should crack, reject it as it cannot realize the whole amount of power it should transmit. If it shows a spongy appearance it should be condemned at once, says Dixie, for it must be pliable as well as firm. The grain or hair side should be free from wrinkles and the belt should be of uniform thickness throughout its length. It should be tested for quality by immersing a small strip in strong vinegar. If the leather has been properly tanned and is of good quality, it will remain in vinegar for weeks without alteration, excepting it will grow darker in color. If the leather has not been properly tanned the fiber will swell and the leather will become softened, turning it into a jellified mass.

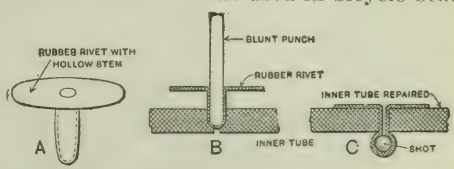
Some people have an idea that a new belt that does not stretch any is the best for transmitting power, but this is a mistake. A belt in this condition is very apt to break when used to transmit variable loads.

HOW TO MAKE STOVE POLISH.

Mix 2 parts of copperas, 1 part of bone black and 1 part of black lead with sufficient water to form a creamy paste. This will produce a very enduring polish on a stove or other iron article. After two applications it will not require polishing again for a long time, as the copperas will produce a jet black enamel and cause the black lead to permanently adhere to the iron.

NEW METHOD OF REPAIRING TIRES.

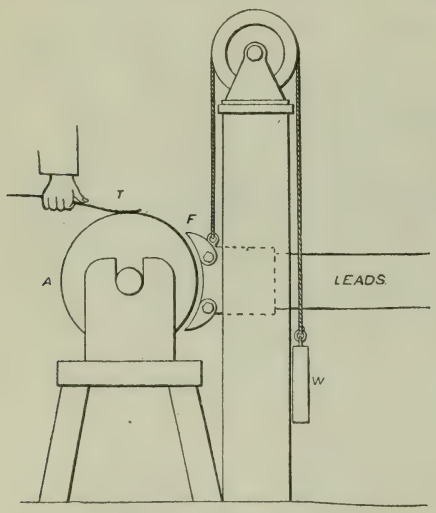
A French firm has announced a new process of repairing punctures in auto tires. Patching with cement has usually been short-lived, and almost sure to leak and deflate the tire at high speed. By the new method, says Machinery, a rubber rivet, A, is used, having a hollow stem. This rivet is pushed through the puncture, using a blunt punch for the operation as shown at B. After the rivet is in position, a shot such as used in shot-guns of about the size known as B or BB, is pushed through the stem until it reaches the bottom where, of course, it enlarges the stem to a considerably larger diameter than it is in the neck where compressed by the walls of the punctured tube. For large punctures it may be necessary to use a steel ball such as used in bicycle bear-



ings. The result is that the rivet cannot become dislocated when in use without tearing off the stem or greatly enlarging the hole. Of course the under side of the rivet head is treated with rubber cement before being placed in position.

INDUCTION TESTS FOR SHORT CIRCUITS.

The drawing illustrates a method of testing armatures for short circuits, reported in the proceedings of the American Railway Mechanical and Electrical Association. The apparatus used in this case consists of an old Baxter motor field, F, suspended between two uprights and balanced with a counterweight, W, so that it may be adjusted to conform to the various heights of different armatures, A. This field is wound with No. 9 wire and supplied with alternating current from a small, belt-driven dynamo. The armature is placed in the magnetic circuit of this field and revolved slowly, and a small telltale piece, T, consisting of a light piece of sheet metal, is held at the top of the armature, as shown. If there are any short circuits they will easily be determined, as the telltale piece will set up a vibration, which can readily be felt by the hand. A device of this kind is one of the greatest money-savers possible to put in an armature repair shop, and it will save many an armature from being needlessly burned out, as the short circuits can be detected in the shop instead of developing after the armature has been placed in service.



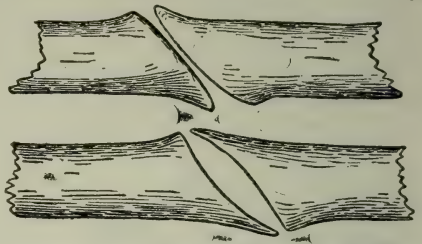
INDUCTION TEST FOR SHORT CIRCUITS.

AUTOMOBILE VS. THE "BUS."

The historic "bus" which for generations has done service between the towns of Kiel, Rheinbishopsheim and Bodersweiler in Baden have been superceded by a modern automobile carrying 20 persons.

RIGHT AND WRONG METHODS OF MAKING A WELD.

Good coal and good materials generally, are among the essentials in the art of welding, writes J. M. Fix in the American Blacksmith. For a good weld have your tuyere



THE RIGHT AND WRONG METHODS OF MAKING A WELD.

iron from four to eight inches under. In other words, have four to eight inches of coal on your tuyere iron depending upon the character of the work you are doing. Coke your coal and beat it down solidly around your fire. Now heat your iron to the welding point—upset and scarf. In order to make the most perfect welds, you must scarf your iron properly. Upset well to allow for wasting away. Have your scarf full in the center, so that the two pieces to be joined will touch in the center first. If there is a hollow in the center, foreign substances are liable to collect in there and cause a very imperfect weld. When they have reached a good, clean, white heat with the scarf down in your fire, take them out and give each one a good jar on the anvil while the scarf is still down, so as to jar off any dirt which may be on them. Reverse or turn over the one you have in your left hand, get them together as quickly as possible and hammer rapidly so as to get them united before the heat gets below the welding point. The cold anvil will reduce the heat below the welding point in a very short space of time. Don't be continually poking at your fire. Let the clinkers gather at the bottom.

MACHINE THAT PICKS COTTON.

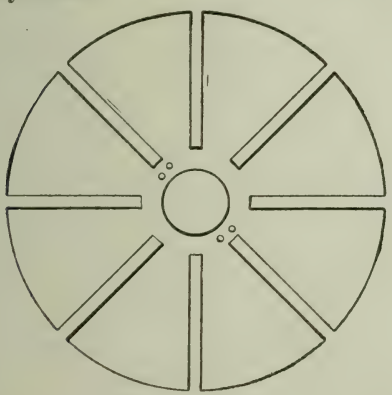
A new cotton-picking machine has been invented. The essential principle of the machine is suction by air, which is produced by fans, the device being pulled across the field by one or more horses. The machine is moved a short distance and then two or three operatives direct the pipe nozzles to the cotton on the eight or ten rows surrounding the machine. The cotton is sucked from the plants as cotton is now sucked from a wagon at a gin.

AIDS INCANDESCENT FILAMENTS.

The Elektrotechnische Rundschau, of Berlin, says: The filament in glow lamps gradually diminishes in diameter in consequence of the slow volatilization of the carbon. A German firm introduces into the glass globe certain chemical compounds with a high boiling point; these, under the influence of the temperature in the lamp bulb, slowly give off vapors containing carbon which is deposited on the filament, thus making up, to a large extent, for the loss caused by the volatilization referred to. Besides it keeps the resistance and the brightness of the lamp more uniform throughout its useful life.

SIMPLE FAN TO COOL DRUM ARMATURES.

A simple home-made fan, easily constructed in any shop, is described by a Canadian writer in the Engineer. It was constructed for use on an armature of the solid-core unventilated type still found in many places. The fan was made of sheet iron. He says: The fan is shown as first made, before the wings are turned. This part I found easy to accomplish by catching the inner ring of the fan in a vise and turning the wings to the proper angle by means of a monkey wrench. When this is done take the dynamo pulley off and slip the fan onto the pulley hub and tie it in position by means of two tie wires run through small holes shown in the inner ring, and around the pulley arm and then twisted, the holes for the tie wires having previously been spaced properly to suit the pulley arms.

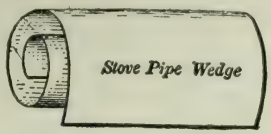


Armature Fan

This will be found to blow considerable air onto the back end of the armature, as well as onto the box on the pulley end of the dynamo.

HANDY STOVE PIPE WEDGE.

A pattern for a wedge for fastening a stove pipe into a chimney is given herewith. Sometimes small things wedge



themselves into one's good graces when larger and more complicated ones cost too much or are not to be had just when wanted, says the American Artisan.

Cut a scrap of sheet iron about 4x4 inches and fold or bend, as shown in cut.

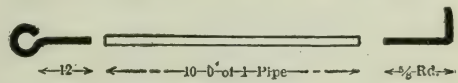
Then pound one end flat and you have a wedge that will hold the pipe securely, for it will spring enough to be very tight in the chimney flue. This wedge can be made on the spot from a scrap cut from the pipe or any bit of old sheet iron.

NEW WELCH TOOL STEEL.

Experiments in making tools of Siemens steel instead of from the crucible, and thereby effecting a great saving in cost, are being conducted in Wales. The new process consists in the use of an alloy, which is a secret. The experiments so far are meeting with success.

HOW TO MAKE A LIGHT POKER.

A long poker, easy to handle because it is light, and which will not quickly heat on account of its being hollow, can easily be made by welding a solid hook at one end of a small wrought iron pipe and a



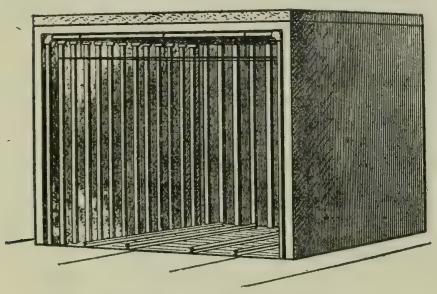
solid handle at the other end. For a poker 12 feet long, 10 feet of 1-inch pipe is about right, and the solid ends should be made from ⅝-inch rod iron. The handle and hook should each be 12 inches in length.

NEW POWERFUL EXPLOSIVE.

The latest in explosives is powdered aluminum mixed with nitrate of "ammonal." It is said to be the safest and surest explosive known. It is not affected by friction or blow. It can only be exploded by an ordinary cap, it is not subject to disintegration, and is not affected by frost or moisture.

HOW TO MAKE A STEAM-HEATED ENAMELING OVEN.

A steam-heated oven for enameling which can be constructed by any mechanic is illustrated in the Metal Wroker. From 80 to 100 pounds steam pressure is required for baking, and the articles to be japanned should remain in such temperature for three hours.



Steam-heated Enameling Oven

The oven shown is much larger than would be required in any repair shop, but its design is such as to permit of easy modification to suit any existing conditions. The oven is heated with live steam, conveyed direct from the main boilers. The walls of the oven are made of two shells of thick sheet iron, so arranged as to form an air space between them. The top is covered with a layer of asbestos about 1 inch thick. The floor is of sheet iron, and in this instance is provided with two tracks, upon which run iron cars carrying the articles to be enameled. This would not be necessary in a bicycle repairing shop, and the bars and hooks could be substituted as in the other ovens. Inside of the sheet iron walls are vertical rows of steam pipes, placed closely together, as indicated. Across the top are other steam pipes. Below the pipes on the ceiling is a sheet iron apron, which serves to catch any dust or dirt that might fall from the overhead pipes. Steam at boiler pressure passes through all of these pipes. It is of the utmost importance in arranging these pipes to provide for their proper drainage—that is, provision should be made for the water condensed from the steam to flow to some point where it could be drawn off.

An extremely uniform temperature can be maintained for any period in this oven. The way in which the heat is applied insures the even heating of every part of the oven. This is essential in an oven of large size, but is of minor value in one of small dimensions designed for the work of a small shop. The degree of heat to be obtained is controlled by the steam pressure available, and higher than this it is, evidently, impossible to go. But any lower temperature desired can be easily and quickly obtained and can be maintained indefinitely.

WAY TO MANAGE A FOUNDRY.

"If a foundry foreman desires to keep his shop up to a high state of efficiency," said an American foundryman recently, "he will, as soon as he receive an order for castings, see that the necessary cores are at once ordered from the core department. Then he will proceed to learn if he has a suitable flask for the casting, and if he has, he will ascertain if any repair work be needed on this, and, if so, he will have this done before the flask is taken to the molder's floor. All repairing of flasks should be done by a flask man instead of by the molder and his helper.

"In order that the molder may use his time to the best advantage, his helper should see that he not only has his facing sand, gaggers, clamps, etc., but he should also look after the many little things which the molder sometimes spends his high-priced time in looking up. Even in specialty shops I have seen molders take a hand in barring up flasks. This they should not have to do as this kind of labor belongs to the flask-maker and the latter will do a better job than the molder every time.

"In a great many foundries the men depend too much upon the foreman for everything. They should remember that he is only human, and has not the time to attend to every little detail. It has always seemed strange, too, that the place where castings are made should receive so little attention from the owners of plants, a majority of whom seem to think that anything can be made to do for this department. Perhaps nearly every practical foreman is familiar with shops where ordinary equipment is so scarce that the molders are spending a great part of their time looking for things of which each should have a plentiful supply. The successful foundry manager of to-day must not only be a practical molder, but also experienced in cupola practice, or he is not fully equipped for the position."

HALF TWISTING A QUARTER TWIST BELT.

I was at one time the proprietor of a planing mill where it was necessary to transmit motion from one line shaft to another where the two were at right angles to each other, says a writer in the American Machinist. The belt was first used in the ordinary way and ran well enough for a while, then it commenced breaking the laces and giving trouble generally. One day the belt was taken down and stretched upon the floor and it was found to be bowed—like an iron barrel hoop when it is cut and straightened out—a result which one can readily see the reason for upon careful observation, as the belt has more tension upon one edge than the other. The belt was then sewn together with a half twist, as shown in the accompanying drawing, with the result that the trouble ceased.

Since that time I have been about the country a good deal and have found several belts running under the same conditions and giving the same trouble and have had the pleasure of suggesting the half-twist remedy, the application of which has always brought the same satisfactory results.

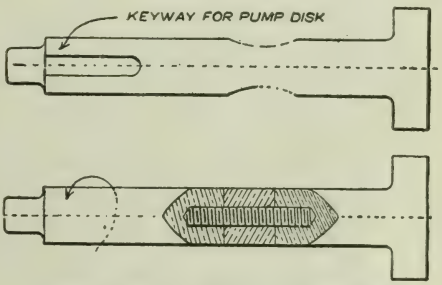
This contribution is offered in the hope that it may meet the eye of someone who is having the same difficulty, whereupon, if he applies the suggested remedy, his troubles will cease.

OPERATING TRANSFER CAR BY CABLE.

The boys were spending too much time pushing the transfer car in a mill, so the superintendent installed a cable system. The following is a condensed description from the Woodworker. A small endless cable was driven from a drum at one end of the mill. One lead of the rope was carried on one side of the track, the return lead on the other, in each case just outside the rails. A grip was placed on each side of the car. To operate the car in either direction the operator has only to close the grip on the side in which the cable is moving in the direction he desires to go.

HOW A PUMP ROD WAS REPAIRED.

Figs. 1 and 2 illustrate the Muntz metal rod belonging to a centrifugal pump, which broke where the packing had worn it to some extent, says Fieldings Magazine, as shown by the dotted lines, Fig. 1. It being necessary to have the pump working as soon as possible, we resorted to the following method of repair. We first drove out the keys, took off the pump disk, faced up the broken ends of each piece of rod in a lathe, drilled up the center of the rod for about 2 inches in each piece, and cut a 1⅛-inch left-handed thread, Whitworth pitch. Next we turned up and drilled a "distance-piece," the length of which was equal to the amount turned off the broken ends, and also cut a thread in the same. Then we turned up a piece of mild steel about 5 inches in length and cut a 1⅛ inch left-handed thread on it, fixed all together as in the sketch, and skimmed up the part that ran in the stuffing-box. If the shaft was driven from the other end in the same direction, of course it would be necessary to cut a right-handed thread. This was much quicker than making a new shaft, cutting keyways, fitting keys, drilling holes, etc. It was only intended for a temporary job, but is still running .



FIGS. 1 AND 2. REPAIR TO PUMP ROD.

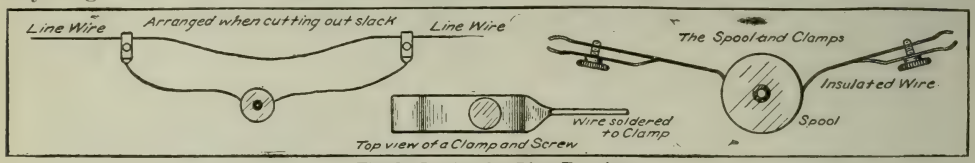
PREVENTS BLOW-HOLES IN STEEL.

To prevent blow-holes in cast steel M. Meslans, of Paris, adds to fluid steel an alloy of aluminum with a metal of the alkali earth group, or with lithium. Aluminum alone does not act upon the nitrogen and hydrogen in the fluid metal. The metals of the alkaline earths and the lithium possess that property, but they are too dear for use alone. An alloy of aluminum and calcium gives the effect of each element, so that carbon monoxide and also nitrogen and hydrogen can be removed.

HANDY DEVICE FOR LINE REPAIRER.

The homemade device shown in the cut will be readily understood by every electrician.

Shown in the drawings is a little arrangement which is handy where it is often necessary to go out on the line and take out the slack, says the American Telephone Journal. Frequently when the repairer pulls up the slack and prepares to make a new splice he cuts the line wide open, and in many cases cuts off a conversation which is taking place. By the use of this little device such annoyances can be avoided. The drawings are almost self-explanatory, but a little description may aid in their understanding. Two clamps are soldered (one at each end) to a piece of insulated wire of a small enough diameter to be easily handled. The wire is then coiled on a spool in such a way that both of the ends are available. When it is desired to cut out slack the wire on the spool is arranged around the point where the line wire is to be cut and connected to the line wire by means of the two clamps. The slack is then pulled and the connection made without interrupting the service. The length of wire to be used will depend on circumstances. Forty feet has been found a handy length.



Handy Device for Line Repairer

NOTES ON STEEL.

The following items are taken from the November issue of Sparks from the Anvil:

In annealing cold rolled steel, gas is turned into the annealing boxes after they are removed from the furnace. The burning of the gas uses up any air that might come in contact with the steel while cooling. By this method the steel comes out of the boxes in bright condition.

* * *

Where a defect occurs in a finished article made of steel, and always in the same place, the steel is not at fault; there is something wrong with the method of making the article.

* * *

The tempering heat is not so high as the annealing heat; the annealing heat is not so high as the hardening heat; and the hardening heat is lower than the forging heat. Always, in practice, bear this in mind. The only exception is in the case of high-speed steel, which is a law unto itself.

* * *

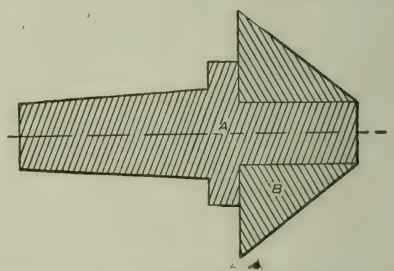
Twist drills hardened in a water bath should be plunged deep enough to harden a short distance on the shank. Water cracks are apt to occur if the drills are held almost stationary in the water. If the drills are soft directly back of the water cracks, it is proof that this portion was held at the water line or so close to it that they did not go into the bath deep enough to harden.

* * *

High speed or self-hardening steel, when required to be cut or broken off into tool lengths, should first be nicked deeply in the bar while hot; or better, should be cut entirely through. Cracks and slivers are liable to be produced if nicked but slightly.

LARGE CENTERS FOR PIPE TURNING.

A is turned from a piece of mild steel to fit the mandrel and roller, with a collar left on to take thrust, while B is turned from cast iron or steel if convenient, and revolves freely on A with the work, which runs much truer than with the usual solid center in a rough pipe.—Engineer.



CENTER FOR TURNING LARGE PIPE.

BLACK INK FOR RUBBER STAMPS.

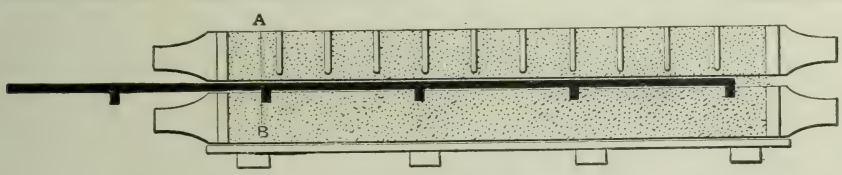
Nigrosin 3 parts, water 15 parts, alcohol 15 parts, glycerine 70 parts. Dissolve the nigrosin in the alcohol, add the glycerine previously mixed with water, and rub well together.

TO BALANCE A LOOSE PULLEY.

A somewhat novel plan for balancing a loose pulley is described as follows in the Woodworker: After it has been bored out ready for use, place it upon a smooth arbor that is solidly supported in place. Wind a cord around the hub, or the rim, according to size of pulley, and give the cord a long, even pull, that unwinds it, giving the pulley the motion due to unwinding process. The inner end of the cord is not tied to the pulley, but left free, except that the cord crosses it to hold the same in place. When the pulley is perfectly balanced it will run a long time without "chattering."

MOLDING SHORTER THAN A PATTERN.

I send you a sketch showing how we made a 5-foot casting off a 9-foot pattern in a 6-foot flask without cutting the pattern, says a correspondent of the American Machinist. We first took the pin off one end of the core, as, the top being a flat surface, a slight shift would not matter; or, to avoid this, we could have bored a hole through the pattern to clear the pin. The pattern was rammed up in the usual way, only the drag was raised from the board the thickness of the pattern, and the pattern projected from the end of the flask. After the cope was taken off and the pattern drawn, we stopped off, as marked by line A B. We did not want to cut the pattern, and we did not have a spare flask long enough to take all the pattern, so this was a case of necessity.



MOLDING SHORTER THAN THE PATTERN.

Cottonwood is worth 40 per cent more than one year ago. It is rapidly becoming scarce and valuable.

WHEN THE WHISTLE BLOWS.

The whirring wheel and the rasking saw
And the hissing plane are still;
There's silence down in the darksome mine,
And silence up in the mill.
The hammer and axe are cast aside,
The shovel and pick repose;
And the sawdust settles in drifts of gold
When the whistle blows.

Beneath the shade of a spreading tree
They sit with their dinner pails,
A group of earnest and brawny men
With muscles as hard as nails.
Their lot is labor from early dawn
To the daylight's weary close,
With an hour of ease when the clock strikes twelve,
And the whistle blows.

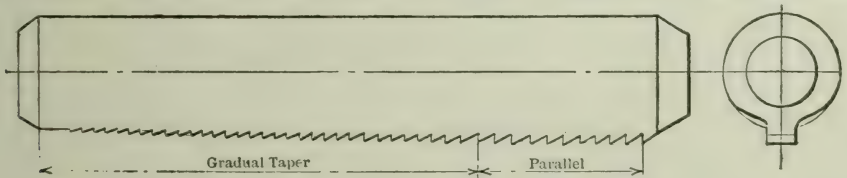
The breeze is fanning their heated brows,
And to some a dream it brings
Of a cottage small, and a garden gay
Where the robin builds and sings;
A window curtained in spotless white
And framed in a crimson rose,
And a smiling face at the open door
When the whistle blows.

They feel no envy of him who dines
From damask and silver rare,
On delicate fruits and costly wines,
With lackeys behind his chair;
For the bread they eat is twice as sweet,
And the rich man seldom knows
The keen delight of the sons of toil
When the whistle blows.

—Leslie's Weekly.

TO CUT SMALL KEYWAYS.

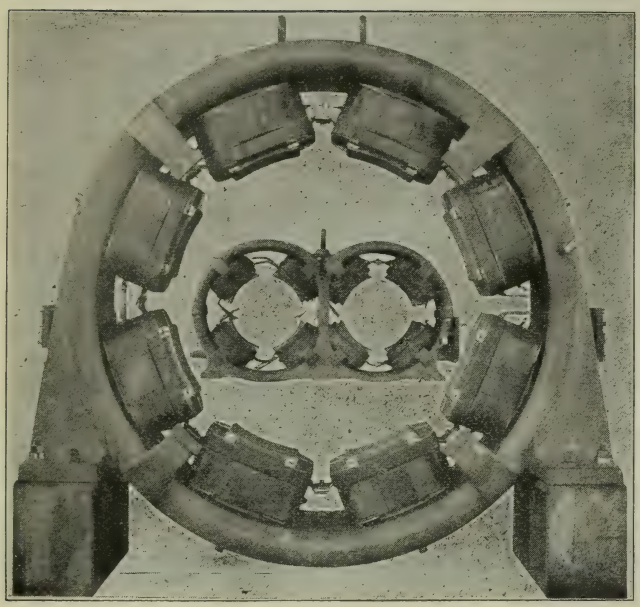
Where small keyways have frequently to be cut in a shop not otherwise equipped the following English kink from the American Machinist may be found useful. A broach, such as shown in the sketch is used, the work being held in a vise, in a bush, and the broach driven through. A broach of this description is very strong and the holes are not injured by it.



COMBINED BROACH AND ARBOR.

A metal roof is said to be positive protection against the building it covers being struck by lightning.

Speed vs. Size



Equivalent High and Low Speed Generators

That an increase in speed requires additional power is illustrated negatively in the cut showing the comparative size of two electric generators. Both are of equal capacity, but owing to the much greater speed of the smaller it produces just as much current as the other. These machines are each 200-kw. capacity; the armature of the larger revolves at 100 revolutions per minute, while the speed of the small one is 900 per minute.

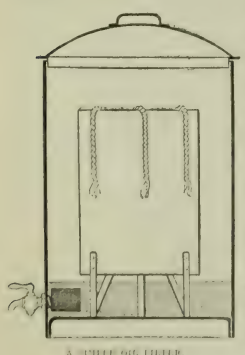
The advantages of the smaller machines are a saving in weight and size. The slow speed machine weighs 35,000 pounds; the high-speed only 9,500 pounds. The larger contains 3,700 pounds of copper more than the other.

Income tax returns show that citizens of Great Britain have invested $5,630,540,500 abroad.

HOME MADE OIL FILTER.

Here is another home-made oil filter to add to several already described in these columns. This one is from The Engineer, and the writer says: "I have a filter which works on the principle of capillary attraction that any tinner will make for $5.00.

First have a can with a top made out of heavy tin or galvanized iron 30 inches high by 20 inches in diameter with a faucet 1½ inches from the bottom, and a strainer attached on the inside of the can.



A SIMPLE OIL FILTER.

Next have a smaller can 20 inches long by 14 inches in diameter, made with three legs. Place the latter inside of the large can. From a dry goods store obtain three rolls of cotton batting and fold it lengthwise making three folds, six thicknesses, then roll it sidewise and tie it with a string to prevent it from unrolling.

Take the rolls and put one end into the small can and let the other end extend over the side into the large can. Fill the small can with new oil pouring some over the rolls and let it stand for eight hours. Capillary attraction will take about eight inches out of the inner can. Then you can fill it full of dirty oil.

The more rolls of cotton the faster it will filter. Be sure not to have any water mixed with the oil as it will filter water as well as oil.

HOW TO SOFTEN CAST IRON.

A German authority says, to soften cast iron, heat the whole piece to a bright glow and gradually cool under a covering of fine coal dust, etc. Small objects are packed in quantities, in a crucible in a furnace or open fire, under materials which when heated to a glow give out carbon to the iron. They should be heated gradually, kept at a bright heat for an hour and allowed to cool slowly. The substances recommended to be added are cast-iron turnings, sodium carbonate or raw sugar. If only raw sugar is used, the quantity should not be too small. By this process it is said that iron may be made so soft that it can almost be cut with a pocket-knife.

PROFESSOR RATEAU ON STEAM TURBINES.

The New Engine that Will Probably Revolutionize Engine Building

At the recent Engineering Conference in London, Prof. Rateau, of Paris, read a paper on the steam turbine. He stated that while C. A. Parsons and the Swedish engineer de Laval are the two foremost names in connection with the development of this type of engine the idea is not new. Its possibilities were indicated by the French engineer Tournaire in 1853 and both Parsons and de Laval have since adopted his suggested plan.

The Engineering Times, London, condenses the following from the paper: As in the case of their hydraulic analogues, steam-turbines may be divided into two principal classes, action and reaction turbines; and each of these classes is subdivided accordingly as the turbine is composed of a single wheel, or of several wheels, traversed successively by the steam in course of expansion. Among re-action turbines (analogous in hydraulics to the well-known "Jonval" turbine), of which, as multiple machines, the prototype is the "Parsons" turbine, the steam is only partially expanded in the distribution, and acquires its full expansion in the movable wheel. The steam, therefore, acts on the blades at once by its pressure and its velocity. The movable wheel is thus subjected on its two faces to pressure of different amount, causing longitudinal thrust, which has to be balanced. These differences of pressure render it necessary to reduce to a minimum the clearance between the movable wheel and the walls by which the steam tends to escape without traversing the blades and so doing useful work. It is indispensable that the distribution of the steam should be effected over the whole circumference of the movable wheel in order to avoid movements of pulsation very prejudicial to efficiency.

In the "action" turbine, on the other hand, the steam only acts on the movable wheels by its velocity. Each wheel revolves in a casing in which the pressure is uniform. Therefore the steam does not produce any sensible longitudinal thrust on the moving parts, which dispenses with the necessity for any special provision to neutralize such thrust. The steam does not tend to rush across the blades in order to pass from one face to the other at the expense of efficiency. It is therefore possible to provide sensible clearance between the moving and fixed parts, and consequently to disregard the wear of the shaft bearing. Further, is is possible, if need be, to project the steam on to one point only of the circumference. Finally, under the same conditions "action" turbines revolve at a less velocity than "re-action" turbines. This renders more easy the direct coupling to the machines worked.

It is not necessary to insist on the well-known advantage possessed by turbines in general of smooth and continuous movement of rotation, but the excessive speed for which they are obliged to be designed in order to meet the speed of flow of the steam constitutes in many cases a serious inconvenience, e. g., in its application to ship propulsion. For a long time this hampered their use for electric installation, but latterly dynamos of very high speed have been constructed, worked by steam-turbines, constituting an outfit of light weight, requiring small space, and although of ample power, of low cost, and, as a consequence of working and upkeep, as simple as can be desired. It follows that for this purpose the steam-turbine may be expected rapidly to supplant the piston-engine.

OIL PRODUCTION IN CALIFORNIA.

The amount of oil consumed on the Pacific coast during the past four years is astonishing, having increased from 4,000,000 barrels in 1900 to over 20,000,000 in 1903. All this oil was taken from California wells.

The oil is found in strata of sand where it is held in suspension like water in a sponge, and lies about 1,000 feet below the surface. Such a well costs $4,000 to put down and in operation. The oil brings 30 cents a barrel at the well. Enterprise gives the following table for estimating the amount of oil suposed to be contained in the oil sand:

One acre of land with sand 100 feet thick contains 155,400 barrels.

One acre of land with sand 200 feet thick contains 310,800 barrels.

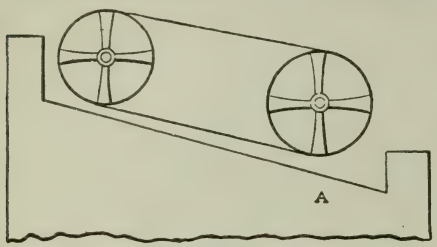
One acre of land with sand 300 feet thick contains 466,200 barrels.

One acre of land, with sand 400 feet thick contains 621,600 barrels.

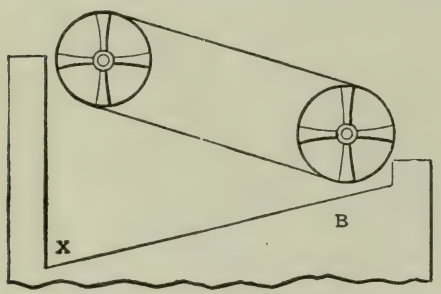
The brains of the Japanese, both male and female, average greater in weight than those of the English or American.

KEEP YOUR BELT PITS DRY.

A certain manufacturing concern which uses a very wide and expensive belt recently had a costly experience. The belt pit, made in the usual manner as shown in the Cut A, filled with water one Saturday night and by Monday morning the belt was nearly ruined. The American Machinist tells how a future accident of the kind may be



prevented. It suggests that belt pits be built as shown in the cut B. Not only would the pit hold a large amount of water before reaching the belt, but at X is placed a trap which allows water to drain to the sewer, but which closes automatically if any back water attempts to enter. In addition a



float should be set to give a continuous alarm on an electric bell in the engine room and office should the water ever reach the danger point.

ECHOES FROM THE IRRIGATION CONGRESS.

The Irrigation Age contains the following in its report of the recent irrigation congress:

Washington correspondent, attempting to be funny at expense of Idaho man, poking at big prize pumpkin: "I say, they raise bigger apples than that where I came from." Idaho man, with contempt: "Apples, is it? Them's not apples, them's huckleberries."

"Best cigar I ever smoked," said the man from Virginia. The Oregon man snickered. "What you laughing about?" demanded the Virginian. "Oh, nothing, but that cigar is made of fresh cured Oregon beet leaf." Virginian puffs away for a while, then: "Well, it goes to show what irrigation will do."

INCANDESCENT LAMP WITHOUT PLATINUM.

L'Electricien, of Paris, says: The Compagnie Generale has been able to entirely abandon the use of platinum in incandescent lamp manufacture. Heretofore attempts have been made to substitute for the platinum one of the ferro-nickel alloys investigated by Dr. Guillaume, but these have not resulted satisfactorily. The method employed by the French firm is based on the use of a special cement, the composition of which is not disclosed. With the cement it is possible to make a perfectly air-tight joint between the leading-in wires and the glass.

HOW TO MAKE PIVOT FILES.

Pivot files, constantly in use by jewelers, may be made from the following directions, according to the Pacific Goldsmith:

Dress up a piece of wood, file fashion, about an inch broad, and glue a piece of fine emery paper upon it. Shape your file then, as you wish it, of the best cast steel, and before tempering pass your emery paper heavily across it several times, diagonally. Temper by heating to a cherry red, and plunging into linseed oil. Old worn pivot files may be dressed over and made new by this process. At first thought one would be led to regard them too slightly cut to work well; but not so. They dress a pivot more rapidly than any other file.

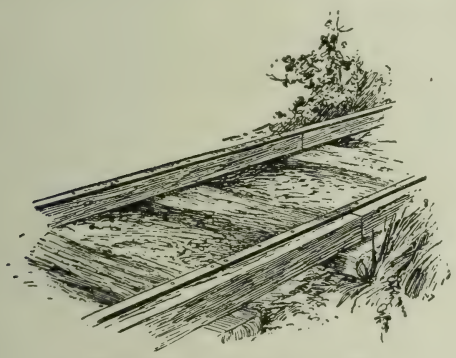
The Noble prize, the blue ribbon of the scientific world, has been awarded by the Swedish Academy of Sciences to Sig. Marconi, the inventor of wireless telegraphy, for making the most important invention of 1902. The prize consists of $40,000 and was provided for in the will of the late Alfred Noble, who died six years ago.

British soldiers with defective eyesight are now required by the war department to wear glasses. This is considered a radical order for conservative England.

Railway Tracks of Early Days

Dewit Clinton Train—1831

In his interesting work, American Railway Transportation, Prof. Johnson devotes a chapter to the first track construction in this country. He says the railway machine consists of three parts, the track, the locomotive and the car. Each had crude beginning, and has reached the present condition of excellence by a long series of improvements. To show how crude these early efforts were he illustrates several types which we reproduce herewith. Many a prominent business man of today rode, when a boy, over these identical mechanical curiosities. Many of the early lines were laid with strap rail on wooden stringers; on others the iron straps were laid on granite sills; and cast rails, in sections 3½ feet long

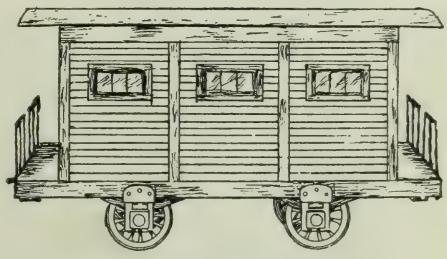


Wood Stringer with Iron Strap

followed. The rolled rail followed next, but the facilities of those days did not permit of rolling a longer rail than 15 feet. Not only were the joints frequent but poorly fastened, and the result was a very rough track, and slow speed, while running off the track was of daily occurrence. The rolled rails weighed 40 pounds to the yard, and were all imported from England until 1844. The cost of iron led to many efforts to substitute wooden rails, and several roads built in this manner were in operation in the South as late as 1850. A thin surface of iron was placed on the wood rails to protect them from wear.

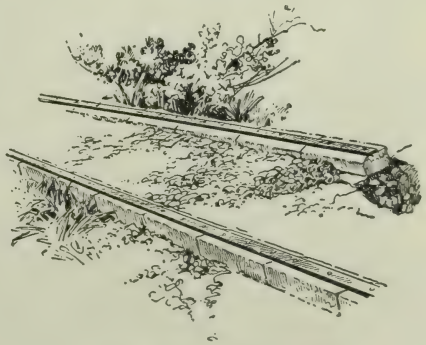
The earlier rolled rails were in the form of an inverted U. The present T-rail was little used during the first 20 years of railroad construction. Steel instead of iron was not common until 1870.

Present day engines and cars are so



Passenger Coach—1835

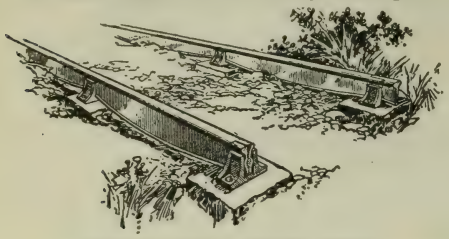
heavy that rails have been enlarged until 100 and 110-pounds to the yard are common: the 100-pound is generally standard on lines of heavy traffic. Thirty feet has been the standard length for some years, although rails 60 feet long have been used



Granite Sills with Iron Strap

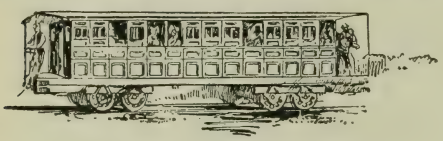
to some extent, not so much by steam roads as trolley lines. A rail 60 feet long, weighing 100 pounds to the yard weighs exactly one ton.

The first locomotive actually run upon an



Cast Iron Rails on Granite Blocks

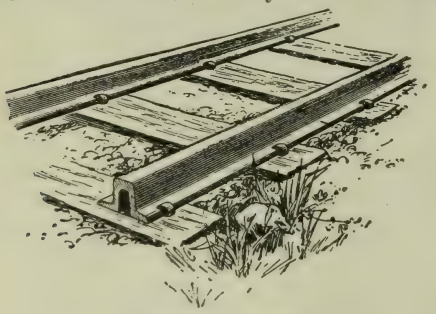
American railroad was the Stourbridge Lion, imported from England in 1829. Locomotive building in this country began in 1830. The Baltimore & Ohio and several other roads which had been built previous



Early Passenger Coach

to this date had been operated with horses.

In 1830 Peter Cooper built the Tom Thumb which weighed only one ton. It was only an experiment. The first locomotive built in this country which actually



Rolled Iron U-Rail

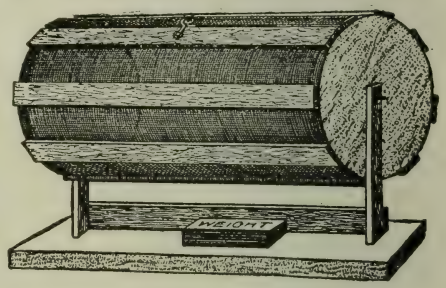
went into practical service was the Best Friend, built in 1830 at West Point Foundry Works. The early cars were equally crude.

AROUND THE WORLD IN AN AUTO.

A New York sportsman will shortly start on a trip around the world in an auto, traveling in his own machine over all the land portion of the journey. He will go from New York to San Francisco, landing at Honolulu, Japan, Hong Kong to Bombay, Italy, Europe and England.

HOME MADE MACHINE FOR WASHING PRINTS.

Amateur photographers will be interested in an arrangement described by one of the correspondents of the Star Weekly. It can easily be made from the following description: Take two pieces of board 10 inches square and make them perfectly round. Then place them 24 inches apart on the floor like two cart wheels, and take some ordinary laths just long enough, 26 inches, to nail them on the outside of each wheel, but before you do this, you must get some mosquito bar 26 inches wide and long enough to reach around the wheels, then place it on each wheel with the outer edge and nail a lath on top of it, then draw the mosquito bar tightly as you go around and



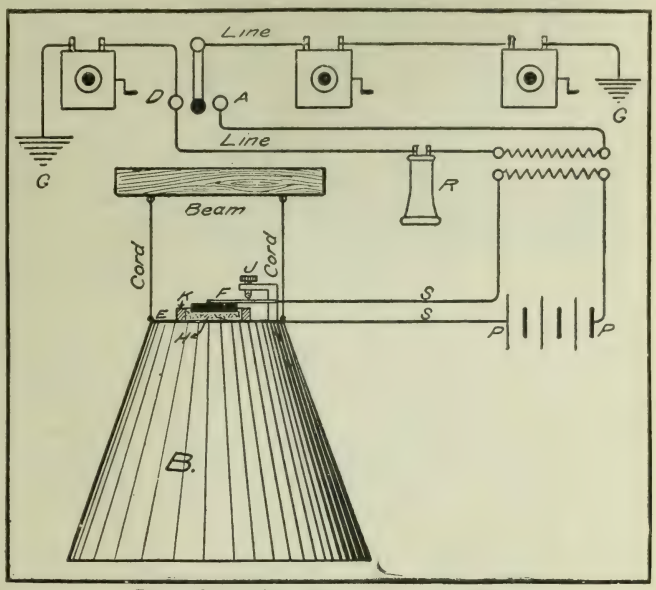
For Washing Prints

nail the laths about three inches apart on the outside of the mosquito bar all around. When you get to the end wind the mosquito bar around the last lath a few times just long enough to reach up closely to the other end, then fasten it with a little hook of wire and leave this as an opening to put in your prints. Then make a little frame 8 inches high, as shown in cut, fastened to the center of each wheel on the outside with a little bolt going through it. At the bottom nail a board, and fasten a little weight on it to hold it down in the water. When all done fill a washtub full of water, or if you have a tank on the place it is better, place your prints on the inside of the washer and keep turning it with the hand to keep the prints in motion. This needs no changing of water and the prints are all done in 30 minutes in the same water. A machine of this size will wash from 75 to 100 4x5 prints at once without touching them with your hand.

A new third-rail device, consisting of a hollow rail with a heating coil in it, to melt snow and ice, has been invented.

HOW TO SEND MUSIC BY TELEPHONE.

The drawing indicates a method that has been used to send music out on a toll line so that all the parties on the line could hear it. The apparatus is crude but has been found to work well and considering the materials from which it was made, has paid for itself many times, says the American Telephone Journal. The transmitter is shown in section, the rest of the circuit being indicated diagrammatically. It will be noted that the transmitting apparatus is suspended from the ceiling by cords. This is done so that the ordinary vibrations of the room will not affect it and also so that it can be easily moved from place to place. B is a tin funnel, 3 inches in diameter at the top and 14 inches in diameter at the bottom. H is granular carbon and F is a block of carbon attached to a strip of metal which is arranged so that the pressure of the carbon block on the granular carbon can be regulated by the tension screw J. The little standard which holds J (which can be an ordinary wood screw) is of seasoned wood. E is a disk of tin which is the diaphragm on which the granular carbon rests and K is a felt ring to confine the carbon to its proper place. The apparatus has been used to send music 50 miles over a party line. The switch D is used to cut the transmitter into the line or to cut the line straight through as is desired. The tension screw J should be adjusted until the listening party says he can hear best.



Device for Sending Music Over Party Lines

USING EXPLOSIVES IN MINING.

Discussing the use of explosives in mining operations, J. H. Karku says: "In soft material the action of a high explosive is too local to make it economical, and a weaker and slower one will give much better results. The charge should be concentrated as much as possible at the bottom of the bore-hole, and chambering the hole gives good results. This may be done by placing a small quantity of high explosive at the bottom of the hole. The primer is placed in this, and dry sand poured into the hole. If now the charge is exploded, the hole will be enlarged at the bottom, and a large charge of explosive can be put in, with which the blasting proper is effected. Never attempt to thaw frozen dynamite by roasting, toasting, or baking it, and never put it in heated vessels, boilers, or before fires. Never put a cap on to charge a primer until ready to use it; and after it is capped, never let it out of hand until it is in the hole. Keep caps away from dynamite; they should never come near each other till they are to be used. Never allow smoking near the powder or explosive. Never use a metallic rammer. Do not get nitro-glycerine on the fingers, as it is absorbed and causes headache. Invariably prepare the primer at a distance from the explosive."

California redwood is being used to splendid advantage in the construction of the big pipes used for conveying water to the electric power houses. They cost less than metal pipes and are more durable.

The principal cause of rails creeping on double-track railroads is that the traffic on a given track is all in one direction, and the heavier and faster the trains the more the rails will creep.

(Written for Popular Mechanics.)

By George Robert Harrison.

Across the lowland's dreary waste,
Where timid marsh-hawks, screaming, fly,
A tall black pipe hurls columns, dark,
Of smoke, up-curling, to the sky.
The long wild grass secretes the grouse,
The rabbit scampers to the hedge,
I hold my ears to half restrain
The shrieking whistle of the dredge.

When autumn sunshine smiles across
The upland meadows where I tread,
When all is calm, I startle at
The sudden signal, "Slack ahead!"
From morning's break till setting sun,
From gloaming till the dawning grey,
At intervals, it weirdly screams,
And slowly, onward, digs its way.

When winds go down, and stars come out,
And soft dews sprinkle o'er the ground,
When all should be sweet restfulness,
I still can hear that dreadful sound.
Like some lone panther's frightful scream,
Or cry of some benighted child,
The old dredge whistle, through the gloom,
Comes to me from the marshes wild.

Across the darkness of the night
I see the headlight's steady glare;
Methinks they are the fiery eyes
Of gaunt hobgoblins prowling there.
My muse, asleep, is rudely stirred;
I try to write, but drop my pen;
I long and wait impatiently
Till I may live in peace again.

IF SAHARA WERE A SEA.

France Revives Talk of the Possibilities of Transforming the Great Desert

French engineers have declared it is perfectly feasible to convert the desert of Sahara into a vast lake, thus opening to commerce great regions of the interior of Africa, which can now only be reached by long, tedious and dangerous caravan journeys. They say that a large portion of the desert lies below the level of the Atlantic, and that by digging a canal to let in the waters of the ocean the great change could be effected easily and at a cost which would be small compared to the benefits which would accrue.

If the whole desert lay below the level of the Atlantic the flooding of it would create a sea more than four times as big as the Mediterranean; but as the Sahara is composed of elevated plateaus, mountain ranges and depressions, only a part would be covered with water when the waves of the ocean were let in, and the new sea thus formed would be an irregular body of water, probably of about the same size as the Mediterranean. Great commercial cities would at once spring up on its shores and trade and civilization strike at once to the heart of Africa. The sea of Sahara may never become a reality, but, in any event, it is a gigantic and pleasing dream.

AN EARLY BUILT IRON VESSEL.

What is believed to be the first steel vessel ever built lies a wreck in the mud flats off the coast of England. She was named the Trial, and carried 45 tons. The mast was stepped in a tabernacle supported by an iron thwart, to enable its being taken down when passing under the bridges on the river Thames.

The Shipping World, London, says: Some idea of the primitiveness of the arrangements on the Trial can be gathered

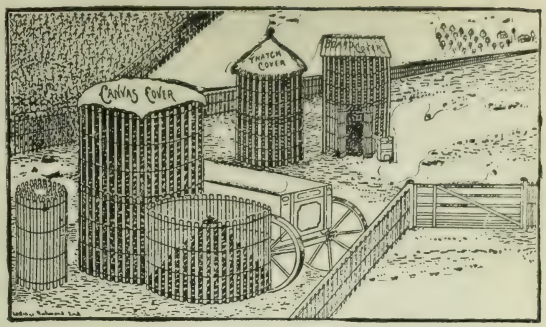
First Steel Ship

from the fact that it was the habit of Captain Benjamin Palmer, the commander, to stow the sail in an open barrel standing on the deck, when it was not in use; and that the crew usually consisted of the captain himself, and a mate. The old Trial, having run the course of her life, now lies half sunk in the mud, just below Coalport Bridge.

M. Curie, the discoverer of radium, has found that the rays of radium color glass a violet blue.

PORTABLE CORN CRIB.

A portable corn crib that can be erected in a few minutes, and built to hold from 100 to 2,000 bushels of corn is one of the recent things of interest to farmers. It is made in sections and can be put together of whatever size and height the owner may desire. It can be taken to any part of the farm, and when filled and covered with canvas makes a very serviceable crib. In summer it serves as a chicken yard.



Portable Corn Crib

EDUCATION FOR EVERY AMERICAN ALMOST FREE.

Great Results or a Philanthropic Undertaking of Noted Professors

Every American who desires may now have an education—no matter what his avocation may be, whether he be rich or poor or whether he live in the country or the city. This results from the successful outcome of a grand and stupendous undertaking on the part of several of America's foremost educators headed by Prof. Eaton of Drexel Institute, Philadelphia. These educators, many of whom, themselves, had risen from the ranks of the poor, put their heads together in the determination that educational advantages should not longer be reserved exclusively for the rich. "Every boy and girl in America who wants an education deserves an education and shall have an education," was their motto. They worked long and silently and now the benefits of their labors are placed at the service of young America.

Through the system which they have devised, 15 volumes, entitled "The Home Study Circle Library," are sent to the student. This is followed up by a series of lessons by correspondence. All is exceedingly comprehensive and by carefully obeying the instructions the student can obtain an American education equal to that of the son of America's richest millionaire. Of course it was necessary to attach a small cost to the service, but it is so little—less than 50 cents a week—that the poorest child in America can avail himself of the magnificent opportunity. The compilation of the volumes and lessons cost more than $30,000, the expense being defrayed by America's public-spirited philanthropists. By a special arrangement with the association thirty beautiful illustrations giving an idea of the elegance of the volumes with complete details of the grand educational offer will be sent free to all who mention Popular Mechanics. In writing address "Home Study Circle Library," 84 Washington avenue, Chicago, Ill.

WHY THEY DON'T WIN.

In a seaport town, on the Atlantic coast,
Two rival hand tubs pump and boast;
At many musters they have raced.
Once in a while one tub gets placed—
The other one "didn't have a show,"
"You should have seen how the wind did blow."
"With the same chance, they'd done better still.
'Twas "too few men," or "the blame was on Bill."
It makes no difference how they play,
Close together or far away,
An even chance was never known
When these two tubs come lumbering home.
Each tub has had her brakes made o'er,
But steel nor brass increased their score.
If Tiger wins her crew is glad,
And Neptune men, of course, are mad;
The other way it's just the same—
Both cannot win, that's very plain.
We've heard so much about these tubs,
Which one's the best. Ah! there's the rub.
A dual meet t'would seem 'bout right,
Both pick their men, prepared to fight;
An equal number on the brakes,
Three judges fair, no rubber tapes;
Ten minutes each, let both tubs try,
'Twould seem enough to you and I.
Some say the tubs are just alike,
Same water ways, same suction pipe;
Some like the fifth hole, some the third,
Both pro and con is oft times heard.
The nozzle, too, is not used right,
Too large, or small, but never right.
Each tub at home works out quite well,
Now let us hope they'll have this meet,
Both tubs prepared, all on their feet,
The distance played will prove to all,
Which one of them "Goes to the wall."

—Newburyport (Mass.) Herald.

Metal Industry says: Steel of a quality equal to that made in crucibles has never been reached by the open-hearth or Bessemer process, and brass always gives better results when melted in crucibles.

"The treatment of steel is the study of a lifetime."

Weaving Silk in America

Weaving silk in America is becoming an important industry since the advent of improved machinery, and the passing of the old spinning wheel and hand loom, whose clatter and click were once familiar sounds in this country. The giant power loom in the great modern factory has supplanted the hand loom, and skilled men instead of women operate them.

The hand loom departed almost simultaneously with the old-fashioned spinning-wheel. The power loom does more than ten times the work of the hand loom, and it was the power loom that made it possible for Americans to become noted as weavers of silk.

The most remarkable invention known to silk weaving is the "jacquard loom." This is not really a loom, but an attachment that can be adapted to any loom. This is the machine which produces, according to the cards designed for it, the most elaborate and beautiful conceptions in silk. Jacquard apparatus is a device applied to looms for weaving figured goods. It consists of a mechanism controlled by a chain of variously perforated cards, which cause the warp threads to be lifted in the proper succession for producing the required figure. The perforated cards are called jacquard cards, and a loom equipped with the jacquard apparatus is called a jacquard loom. All derive their name from Joseph Marie Jacquard (pronounced zha-kar'), the noted French inventor, who died in 1834. The "Dobby," a smaller machine, is utilized for working fancy stripes and what are known as "shaft" effects. Jacquard tie silks are always more expensive than the "shaft," or plain weave fabrics, as the cost of erecting jacquard looms and equipping them with new patterns is greater.

The pattern worked out by the jacquard is made by talented designers; hundreds of cards have to be cut for the loom, so that the pattern may be woven according to the water color design of the artist, and the loom equipment is expensive. For the plain goods the design or pattern may be worked out by the weaving foreman, under whose direction the loom can be readily changed from one pattern to another at small expense as compared with the cost of the jacquard work.

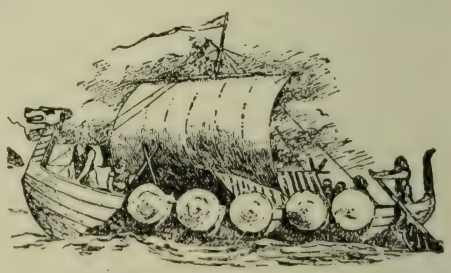
Very beautiful designs in silk are also obtained by warp printed patterns. These designs are printed upon the warps which pass through a series of rollers engraved with the pattern, and the warps are afterwards put into the looms and woven or embellished with stripes and bars to add to their beauty.

However the silk fabric may be treated, whether the weave be plain or figured, the finishing is always important and forms a separate department. The fabric is subjected to a number of processes, sprayed with liquid glue, gum arabic, mixed with soap, is then passed over hot rolls or calenders and comes out brilliant with a firm body and as smooth as can well be imagined. The silk fabric is then taken to the shipping room, where it is folded, wrapped and packed for delivery to the salesroom.

America now manufactures 80 per cent of the silk used for dress goods, broad silks, including tie silks, linings, etc., and 85 per cent of the ribbons used in the United States. According to the last census report, the United States manufactures in round numbers $107,000,000 worth of silk goods and imports less than $27,000,000 worth from Europe. A few years ago we were entirely dependent upon France and Italy for our silk. America imports $45,000,000 worth of raw silk annually. More raw silk is sold in New York each year than is consumed in France, the greatest silk consuming country in Europe. The American looms turn out 6,000,000 yards of silk annually. In this production Connecticut leads, Massachusetts is second and New Jersey third.

QUEER SHIP DUG UP IN IRELAND.

A queer ship was recently dug up in Ireland. Strange to say it was not made by



Queer Irish "Viking" Ship

the Norsemen, much as it resembles a Viking ship. It is the work of the ancient seamen of Ireland.

The Forests are the Nation's Life

The Most Vital Internal Problem in the United States Can Only be Solved by Trained Foresters

By Theodore Roosevelt

I believe that there is no body of men who have it in their power today to do a greater service for the country than those engaged in the scientific study and practical application of approved methods of forestry for the preservation of the woods of the United States. The forest policy of any country must be an essential part of its land policy. The object of our forest policy is not to preserve the forests beause they are beautiful, though that is good in itself, nor because they are refuges for the wild creatures of the wilderness, though that, too, is good in itself; but the primary object of our forest policy, as of the land policy of the United States, is the making of prosperous homes. It is part of the traditional policy of home making of our country. Every other consideration comes as secondary. The whole effort of the government in dealing with the forests must be directed to this end, keeping in view the fact that it is not only necessary to start the homes as prosperous, but to keep them so. That is why the forests have got to be kept. You can start a prosperous home by destroying the forests, but you cannot keep it prosperous that way.

Forestry means making the forest useful not only to the settler, the rancher, the miner, the man who lives in the neighborhood, but, indirectly, to the man who may live hundreds of miles off down the course of some great river which has its rise among the forest-bearing mountains.

The forest problem is in many ways the most vital internal problem in the United States. The more closely this statement is examined the more evident its truth becomes. In the arid region of the west agriculture depends first of all upon the available water supply. In such a region forest protection alone can prevent the great and destructive floods so ruinous to communities farther down the same streams that head in the arid regions.

The relation between the forests and the whole mineral industry is an extremely intimate one; for, as every man who has had experience in the west knows, mines cannot be developed without timber—usually not without timber close at hand. In many regions throughout the arid country ore is more abundant than wood, and this means that if the ore is of low grade the transportation of timber from any distance being out of the question, the use of the mine is limited by the amount of timber available.

The very existence of lumbering, of course—and lumbering is the fourth great industry of the United States—depends upon the success of our work as a nation in putting practical forestry into effective operation.

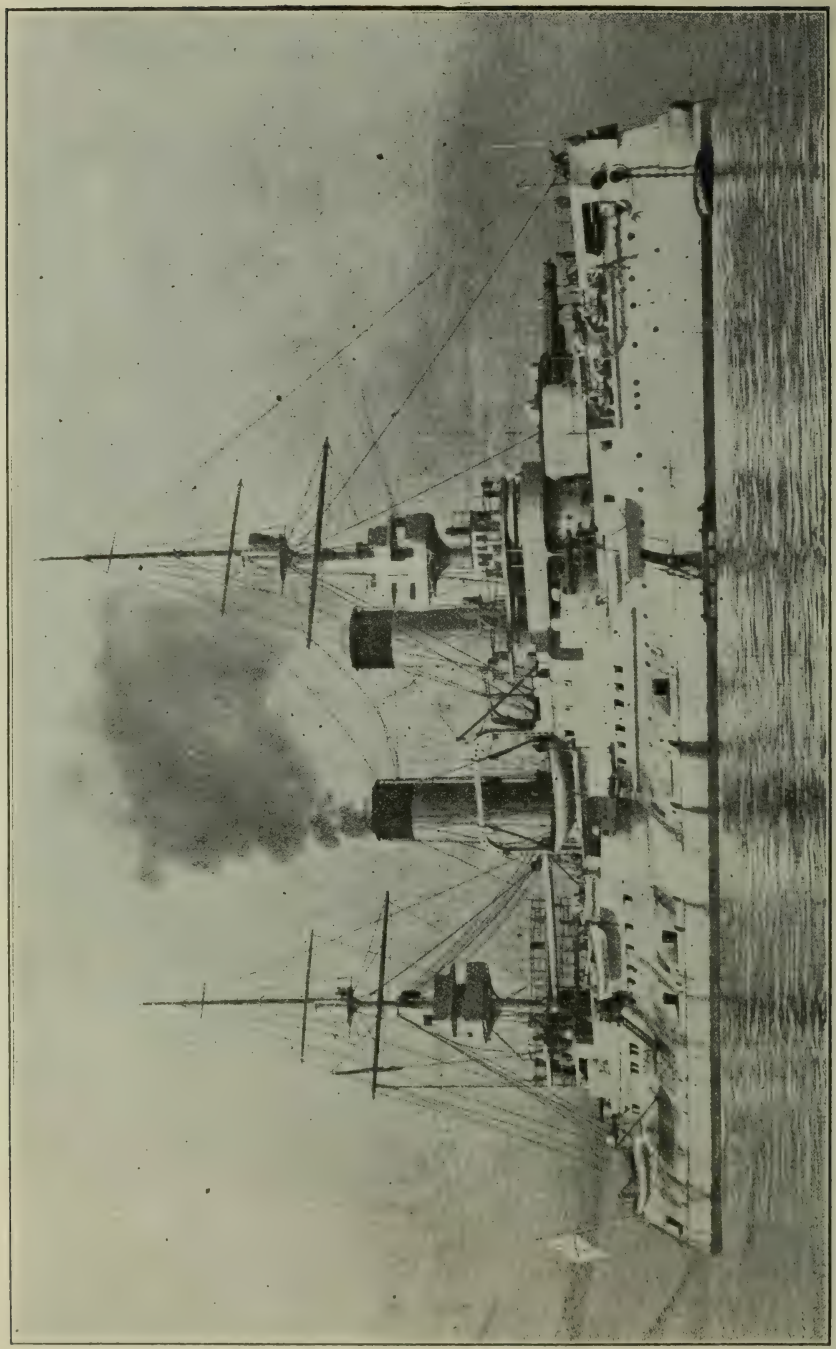
As it is with mining and lumbering, so it is, only in a less degree, with transportation, manufactures, commerce in general. The relation of all these industries to forestry is of the most intimate and dependent kind. It is a matter of congratulation that so many of these great industries are now waking up to this fact; the railroads especially, managed as they are by men who are compelled to look ahead, who are obliged by the very nature of their profession to possess a keen insight into the future, have awakened to a clearer realization of the vast importance of the economic use both of timber and of forests.

Even the grazing industry, as it is carried on in the great west, which might at first sight appear to have little relation to forestry, is nevertheless closely related to it, because great areas of winter range, available and good for winter grazing, would be absolutely worthless without the summer range in the mountains where the forest reserves lie.

The forest resources of our country are already seriously depleted. They can be renewed and maintained only by the co-operation of the forester with the practical man of business in all his types, but, above all, with the lumberman.

The United States is exhausting the forest supplies far more rapidly than they are being produced. The situation is grave and there is only one remedy. That remedy is the introduction of practical forestry on a large scale, and, of course, that is impossible without trained men, men trained in the closet, and also by practical field work under practical conditions.

Russia's Newest Naval Terror



First-Class Battleship "Cesarovitch."

Russia's Monster Battleship--The "Caesarovitch"

It has been said that Russia's aim is to rule the world; that the acquisition of Corea is only the beginning of that nation's colossal scheme that will soon absorb China and work revolutionary changes on the map and in history.

Probably it is this ambition that has been the hidden cause of the great and formidable warships that have silently been added to the Russian navy of recent years. The newest and most terrible of these is the "Caesarovitch." This monster is a battleship of the first class that weighs 13,110 tons, has 16,300 horsepower and makes a speed of 18 knots an hour. Its armament consists of four 12-inch 40 caliber guns; twelve 6-inch rapid fire 45 caliber guns in pairs in six turrets; twenty 12-pounders, 12 in casemates amidships; twenty 3-pounders, six 1-pounders and four maxims. There are six torpedo tubes, one in the stem, one above water in the stern, two above water forward, and two submerged broadside.

The following data as to the ship's armor protection is contained in the Journal of the United States Artillery:

"Armor Protection:—Water-line belt k. s. 6.5 feet wide, 1 foot 8 inches above water, 9.75-inch amidships, tapering to 6-inch at lower edge, 5.75-inch at ends; above this another belt 6-inch k. s. tapering to 4.75 in. at ends, extending 5.5 feet above main belt. Turrets for heavy guns, 10-inch; for 6-inch guns, 6-inch; casemates, 3-inch; armored deck, upper flat, 2-inch; lower, amidships, 4-inch."

Ignominy of a Noble Government Transport

The "Grant" Being Transformed into Mammoth Dredge to Dig Mud---Will be the Largest in the World

No longer will the big transport "Grant" carry United States troops to plant the stars and stripes in far off ports. The transport, which in building and repairs cost $2,000,000 and which did such noble service between San Francisco and Manila during the Spanish war, is now being turned into a mammoth dredge to dig mud from the mouth of the Columbia river. It is quite a fall in dignity for the veteran vessel, but it will doubtless serve the nation well and with distinction in its new though less exalted avocation.

The "Grant" will become the largest dredge in the world, and will be unlike any other dredge ever built. The enormous engines with which the transport is equipped will be utilized in working the great dippers, for the "Grant" will be known as a "dipper" dredge.

It is the problem of digging a ship's channel into the open sea at the Columbia's mouth that caused congress to appropriate money for converting the "Grant" into a dredge. Just such a powerful machine is needed in this difficult work, where it seems the ocean is constantly endeavoring to shoal the channel. Some years ago the government built a jetty which, starting just south

U. S. Transport Grant Converted into a Dredge

of the river's mouth, extended for several miles into the ocean. This jetty has done good work in deepening the channel, but it was not sufficient for the demands of the growing commerce of the Pacific coast. The new work, for which congress has made an appropriation, will include an immense amount of dredging by the "Grant" and the extension of the jetty three miles further out. Several years will be consumed in the improvements.

The "Grant" is now at the Mare Island naval station, California, undergoing the transformation.

WOMEN AS INVENTORS.

Hundreds of patents are taken out each year by women, and patent attorneys say that scores of valuable inventions originated in the bright minds of women never are heard from because a woman is much less inclined to think of applying for a patent than a man. It is also stated that a larger proportion of patents granted women prove successful money makers than an average equal number issued to men.

The United States Patent Office was opened in 1790, but there is no record of any patents being granted to a woman until 1809. This was not for a corset, but the second patent to a woman, which was in 1815, was, and ever since about one-sixth of all the patents to women are for corsets. The greater part of the balance are for articles pertaining to wearing apparel, personal adornment, and household utensils and articles.

In the mechanical line can be found hundreds of useful inventions which have been patented by women. These include washing machines, sewing machines and attachments, dish washing machines, wash boilers, egg beaters, steaming apparatus for shaping pantaloons, pea sheller, type writers, clocks, toys; while one of the best army canteens yet devised was a woman's idea and patent.

Many a woman has reaped a large fortune from a patent, which was the result of an ability to realize the advantages to be secured by some slight improvement in some old method. Many others have thoughtlessly given a valuable idea to some one who immediately set to work to secure the prize and reaped the reward.

WHAT INVENTIONS HAVE DONE.

The natural resources of America have made possible the rapid growth in population, industry and wealth which has amazed the world, but without the inventor how far short of present advance would we have been today? If a thing is particularly hard to do, or a great many articles of one kind are desirable, the Yankee genius soon finds a way to do it with the least labor, in the shortest time and at the least expense. The history of American invention is an intensely interesting study, in which great fortunes gained through successful inventions, stand out in bold relief at frequent intervals.

REGARDING CHARGES FOR INFORMATION.

To the Editor:—Is it customary for patent attorneys to make a charge for reply to a letter of inquiry as to the advisability and cost of taking out a patent. I am not near any large city where I can consult a patent lawyer personally, but do not want to incur a large fee without knowing just what the cost will amount to.—C. E. T.

Answer:—Our reader need not hesitate to correspond with any reputable patent attorney regarding the expense of securing a patent, nor will attorneys in good standing make any charge for information as to the amount of research, etc., necessary to prepare the application. Any of the patent attorneys advertising in this magazine will cheerfully answer any reasonable question necessary to enable the inquirer to decide whether it is worth while to patent or not; and will send much valuable information entirely free to inventors who contemplate taking out papers.

NEW MEXICAN PATENT LAWS.

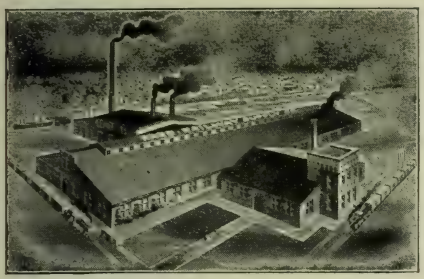
Mexico has adopted new regulations respecting the granting and use of patents in that country. A copy of the new patent laws is on file in Washington at the department of Commerce and Labor, together with a translation in English, where it can be examined by interested parties.

The Book and Newsdealer, New York, says in its November issue:

"Popular Mechanics is almost tickled to death over its change from weekly to monthly publication. We have had reports from about twenty news dealers here in the city, and every one of them sold out their September supply in from three to ten days, and nearly all of them had taken double or more the number they had previously been selling of the weekly. Reports from other news dealers in different parts of the country tell the same story. The edition for October was 40,000—an increase of 8,000 since July. Looks like reaching the 50,000 mark in January."

A modern power house where reciprocating steam engines, gas engines and steam turbines will all be running will form one of the most interesting exhibits to mechanics at the St. Louis fair.

A SOUND INVESTMENT



The Railroads of America are earning more money than ever before in the history of the country, largely because they have reduced the cost of operation to a minimum by the introduction of every device which will save expense and increase the efficiency of their service.

That is why you never hear of a Railway Supply Company in difficulties. That is why such companies are usually owned by a few rich men who reap the harvest which comes from the tremendous demand for patented devices and supplies to be used on the 194,000 miles of railroad in this country alone.

WARD RAILWAY SUPPLY COMPANY

This company, which owns the factory illustrated above, owns and controls eight distinct railway and steamboat appliances, besides other valuable trade already established, can with economical manufacturing and management earn an annual profit of over $250,000.00.

It is to enable us to accomplish this that we have increased our original capital from $25,000.00 to $300,000.00.

Our whole financial plan is moderate and simple. It means that whereas certain of our patented railway appliances are now being manufactured for us by other concerns, we propose to enlarge our facilities and manufacture these appliances ourselves and give the manufacturers' profit, which is very large indeed, to our own stockholders.

That is all there is to it.

Of the $300,000.00 stock we have placed in the Treasury of the Company $150,000.00, and the proceeds of this sale of stock belongs solely to the Company. We have no watered stock and no promoter's stock.

THIS TREASURY STOCK WE OFFER AT PAR

It will earn 30 per cent the first year. This expectation is well founded. Manufacturing enterprises in our line conducted on businesslike principles and without the excessive capitalization, so common of late, always yield large returns. There are hundreds of such companies that you do not hear about because their securities are not listed on Stock Exchanges.

WE HAVE NO PREFERRED STOCK AND NO PREFERRED STOCKHOLDERS

We sell to railroads; they never fail to pay for their supplies. Don't forget that, and don't forget that you cannot say that of any other business, not even banks. They do not always pay their obligations.

IF YOU HAVE ONLY A SMALL INCOME WHY NOT INCREASE IT 100 PER CENT

Shares are $50.00 each. Send us $100.00 if you have no more. This will earn you $30.00 the first year, $60.00 the second and $100.00 the third year. Write for prospectus.

Ward Railway Supply Co., 267 Dearborn St. Chicago, Ill.

BOWLING GIVES HEALTH AND STRENGTH.

Mechanical construction of the balls counts for more than many persons realize in skillful bowling. Perfect balls are difficult to obtain and but few manufacturers seem to have discovered the secret of their construction.

Bowling, like all other athletic sports, has its benefits and injuries to the human system. In bowling ten pins, however, with the finger hole ball, the finger or thumb will give out before you can injure any part of your body. Bowling brings into play every muscle of the body without overtaxing the strength or developing one organ at the expense of another, physicians are giving it their unqualified endorsement.

Nothing enfeebles and lowers the bodily mental tone more than entire giving up of all the energies to one single pursuit; the overworked merchant, or professional man, however, has only to bestow an occasional day upon any of the various athletic exercises within his reach and he speedily recovers himself and instead of losing way in the course which he is pursuing he is enabled to do more than make up the lost time which his absence has occasioned by the increased vigor which his change of scene and occupation has given him. This is so well understood in our large cities that many of our first merchants make a regular practice of devoting one or two days each week to some kind of amusement. They take, however, to various methods, but all act upon the principle of unbending the bow to enable it to regain its spring.

Bowling has become a reputable and fashionable recreation and to become a good bowler is recognized as an accomplishment not to be despised. To reach proficiency requires practice, study, thought, the application of art and careful attention to the various requirements of the pastime, especially to that of the delivery of the ball.

Some claim bowling is the only athletic sport that does not require an instructor, that no two bowlers bowl alike and that you have nothing to learn. This is a mistaken idea. If beginners were instructed as to how to start and what kind of a ball to use they could secure better results and without injury to themselves.

Great preparations are now being made for the national bowling tournament to be held in Cleveland in February. Contracts for the alleys have been let to the Brunswick-Balke Collender Co.

MUD DEPOSIT OF THE MISSISSIPPI.

Thousands of tons of our very richest soil, equal to hundreds of acres of the best farming land, are washed away and carried down to the Gulf each year by the Mississippi river.

In a recent lecture before the Franklin Institute Prof. Lewis M. Haupt stated:

It has been estimated that the volume of sediment carried into the Gulf each year varies from 250,000,000 to 278,000,000 cubic yards, but it is also stated that the banks are constantly caving at the rate of about 9 acres per mile of river and that their average height is from 30 to 45 feet, which would contribute about 332,000,000 cubic yards to the bed of the stream, independently of the amount fed by the tributaries, which is no doubt much more, so that the net amount of sediment left in the bed would exceed that deposited in the Gulf, if it be prevented from spreading beyond the bank by levees. Hence it must follow that unless the ejecta are equal to the injecta the excess must contribute to elevation. This may readily be accepted as a fact when it is seen that a single flood may cause deposits on a level amounting to from 6 to 12 inches of mud.

BOOKS OF THE MONTH REVIEWED.

PRACTICAL JOURNALISM, by E. L. Shuman, 165 pages, D. Appleton & Co., New York. Price $1.25. A book by an old-time newspaper man, on how a daily newspaper is made. Interesting to all and instructive to the young man or woman who has a desire to engage in daily newspaper work. Several leading dailies are taken as examples for analyzing the organization and operation of the editorial department.

AMERICAN RAILWAY TRANSPORTATION, by Emory R. Johnson, Ph. D., 434 pages, illustrated. D. Appleton & Co., New York. Price $1.50. This work defines transportation, in the introduction and then discusses general railway and steamship problems under four divisions: The American Railway System; The Railway Service; Railways and the Public, and Railways and the State. Professor Johnson has placed in readable and instructive language a large amount of information and data, which will be found extremely helpful to any student of transportation problems.

SPECIAL OFFER TO POPULAR MECHANICS READERS: Many people believe that instruction in electricity cannot be given outside the class room. To demonstrate the standard, scope and methods of our instruction, we have bound up four representative text books of our Electrical Engineering Course in a handsome linen cover under the title of "Practical Lessons in Electricity," and will send one copy for 75 cents to every reader of Popular Mechanics who will send us the names of two friends interested in electricity, mechanics, civil engineering, textiles, or architecture. The books are easily worth $3. Address room 108 G., American School of Correspondence, Armour Institute of Technology, Chicago, and be sure to mention Popular Mechanics.

Popular Mechanics

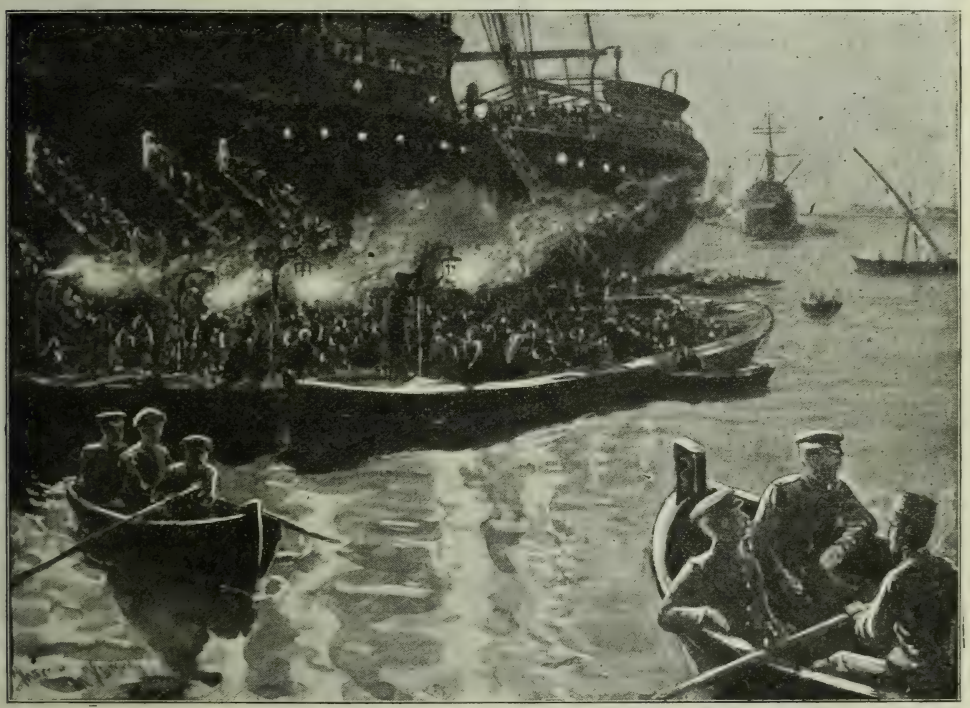
Vol. 6. No. 2. CHICAGO, FEBRUARY, 1904. 10 Cents a copy. $1.00 a year.

How England Plays the Game of Nations

Makes Other Countries Do Her Fighting--The Japanese-Russian Controversy and Its Real Cause

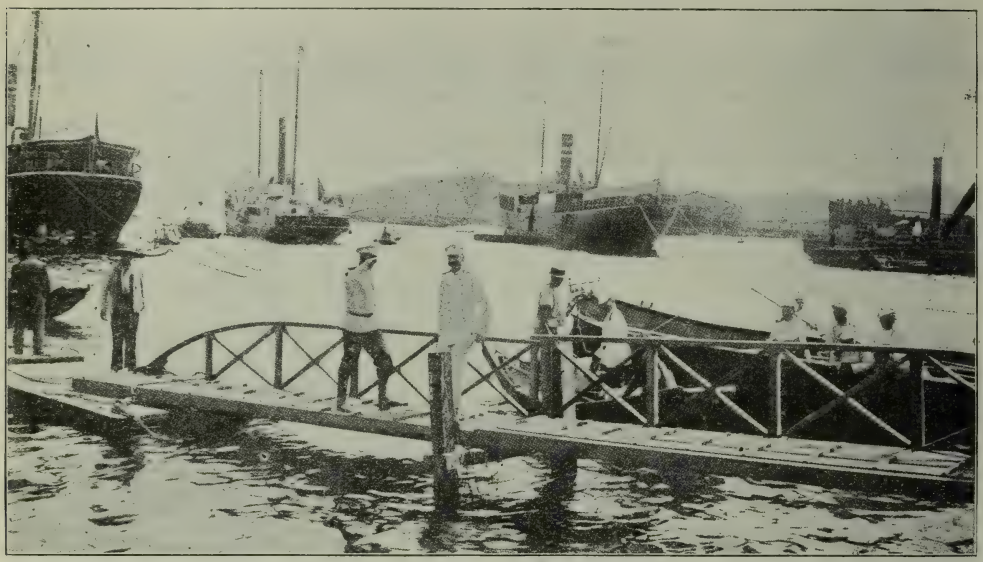
For weeks there has been the ringing and clinking of the cannon-smith and the shipbuilder's tools on board the Russian and Japanese warships. Their riggings and armor overhauled and polished, their guns all placed and tested, the vessels of the two opposing fleets have long waited in seeming readiness to begin the work of destruction and death. At Port Arthur, Vladivostock, Seoul, Mesampho, and Fusan there has been the greatest activity in placing the shops in fighting trim, providing war equipment and distribution of supplies. Chicago has shipped great supplies of war meat to the army departments of the opposing nations and Minneapolis has been busy filling orders for flour.

Late information, however, indicates a temporary postponement of hostilities, unless Japan decides to force a conflict despite Russia's concessions. The Czar is proving to the world that he was in earnest regarding his peace policy and now seems determined to prevent a conflict even though Russia should suffer the loss of territory, prestige and important strategic positions in the East. At first the newspapers scoffed at the Czar's attitude, alleging that



Coaling the Russian Fleet at Port Said

his advocacy of universal peace was all hypocrisy and designing, but late developments have destroyed all doubt to the unprejudiced that Russia's ruler is unalterably opposed to the horrors of war and that Russia in action as well as in word is willing to lead the way to an international agreement that will abolish war for all no less consequence than waging a war for her. "Rule Britania" is Britain's national air and motto, and Britain's known object is to rule the world. Therefore, it is with constant dread that Britain views the increasing population of the great territory stretching across two continents and ruled by the Czar.



In the Harbor of Port Arthur, Russia's Chief Naval Base in the Pacific

Three transports are gathered with the armoured vessels at Port Arthur. Japan thinks that by right of conquest she should have retained Port Arthur after the war of 1895. She was forced to surrender it by diplomatic action on the part of other Powers. Russia can dock and repair at Port Arthur, and a new dock is approaching Completion at Dalny.

times to come. It would be greatly to Russia's advantage to avert war until her vast territory is more thickly populated. But it is not believed that the Czar's desire for peace, nor the intercession of nations can long avert the threatened war. Diplomats agree that it is an unavoidable event in the game of nations, and that all the Czar can do at present is put off the conflict until another day.

It is not Japan, but England, that is to wage the war on Russia. Japan is only one of the chess-men that the British Empire is moving to checkmate the great accumulating power to the north and east and nearly everywhere—the Russias. It is England's old policy to let other nations fight her battles. Whenever England enters into a treaty with another nation it is pretty certain that that nation will soon be called on to perform some very important service for England—a service of probably

English diplomats, by their fine scheming, are usually able to bring about strained relations between any two nations they desire and such is always done when England desires something that a threatened or actual war is necessary to accomplish. These diplomats only strive to keep their work secret and to keep it from being known that England is back of the controversy, but when an after-study is made of the conditions England's fine hand can be seen in nearly every war and strained relation that has occurred in the world in many a year.

So England's desire now is to create antagonism towards Russia among all nations. War news furnished to the world's newspapers may be dated St. Petersberg, Vladivostock, Port Arthur or Tokio, but it always comes from London, and is the war news that England's newspaper correspondents send from the fields of hostilities.

Thus such information, while it may sometimes appear hostile to England on its face, is generally just such information as England desires to be sent and thus the world's opinion is molded as London desires. Americans might have noticed the change in

Where the Warships Are Held in Leash

The Russian fleet is divided into two parts—one at Port Arthur and one at Vladivostock. These ports are 1,200 miles apart by sea. The Japanese fleet is concentrated in or around the dockyards at Sesesho and Kure. Great mountain ranges seam Korea from end to end. If the Nipoonese admiral is a good seaman he ought to prevent the Russian fleets from uniting and if Japan can catch first one of the Russian fleets and then the other it can easily beat them both.

sentiment of this country toward Russia of recent years. This change came despite Russia's supplication for the United States to remain friendly.

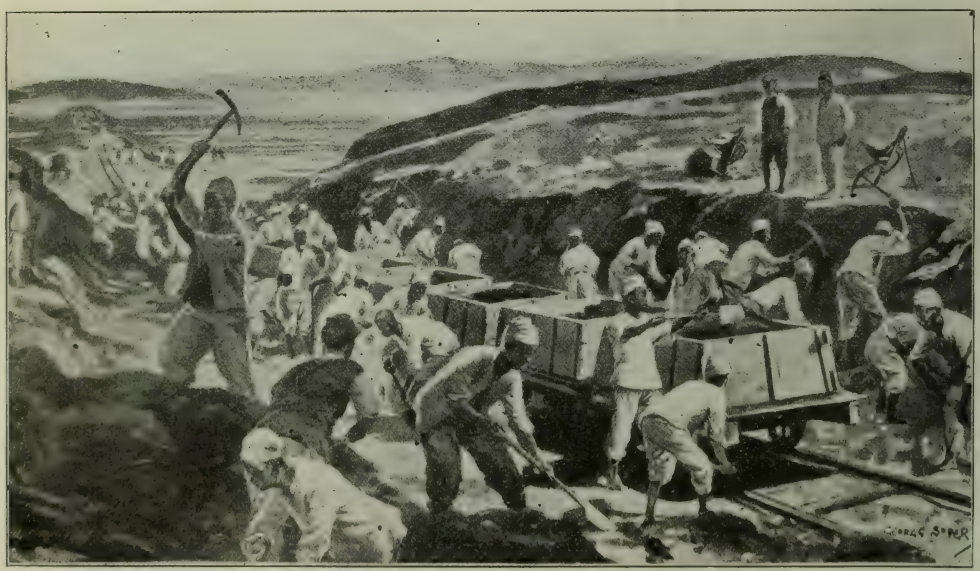
The Russo-Japanese war when it comes will be of world-wide importance. It will not merely determine the fate of Corea or Manchuria or even of China, but it will change the conditions of all Europe and maybe of the world. It will determine as to whether the lion or the bear is to dominate. This is why diplomats say the war must come. Russia and the British Empire are too big for both to exist in the same world at the same time. Besides Russia refuses to become allied with England in any way or to adopt any of England's policies of trade expansion. If so, England

would soon control Russia commercially, and that is the kind of control England desires, even if Russia should not go to war.

The controversy with Russia was provoked by England and has been long approaching. The permission for the United States to dig the Panama canal, the open door in China, permission for the United States to acquire Panama in digging the Panama canal and the treaty between England and Japan were all events carefully planned in London leading up to the present disturbance.

The London Graphic says: "It has always been one of the chief maxims of British foreign policy that great maritime highways like the Straits of Korea, the Straits of Gibraltar, the Bosphorus, and the Sound, for example, must never be allowed to fall within the control of any strong Power, with the exception, bien entendu, of Great Britain herself. Of late years this maxim has been modified, chiefly by Lord Salisbury, in the direction of adding to the exception such other Great Powers as are sufficiently friendly to Great Britain as to render all hypotheses of a serious conflict with them unreasonable. Thus, after resisting for generations the attempts of the United States to obtain control of the Isthmus of Panama and of the Island of Cuba, as calculated to command one of the entrances to a possible Panama Canal, Lord Salisbury agreed to terminate the Clayton-Bulwer Treaty in which this policy was embodied, and to give a free hand to the United States in the conviction that the control of the proposed highway by America would never be detrimental to us."

Russia's policy is to acquire all adjacent territory possible. She has long had her eyes on China, even now dominates Manchuria and considers the acquisition of Korea of exceptional importance in that it would enable her to dominate one of the great maritime highways of the world. The Straits of Korea divide—or one might say, unite—the Sea of Japan and the Yellow sea. A strong power established at Masampho could easily render intercourse between the two seas a difficult matter. Russia at Mesampho would be a perpetual menace to England, and would seriously disturb the balance of power, making Russia impregnable. Russia with her vast territory is increasing her population of 120,000,000 at the rate of 1,500,000 annually. Marching steadily, almost resistlessly toward the Pacific; advancing with railroad and army and traders and acquiring possession of the most strategic points on the Eastern map, it would soon be that nothing could stem



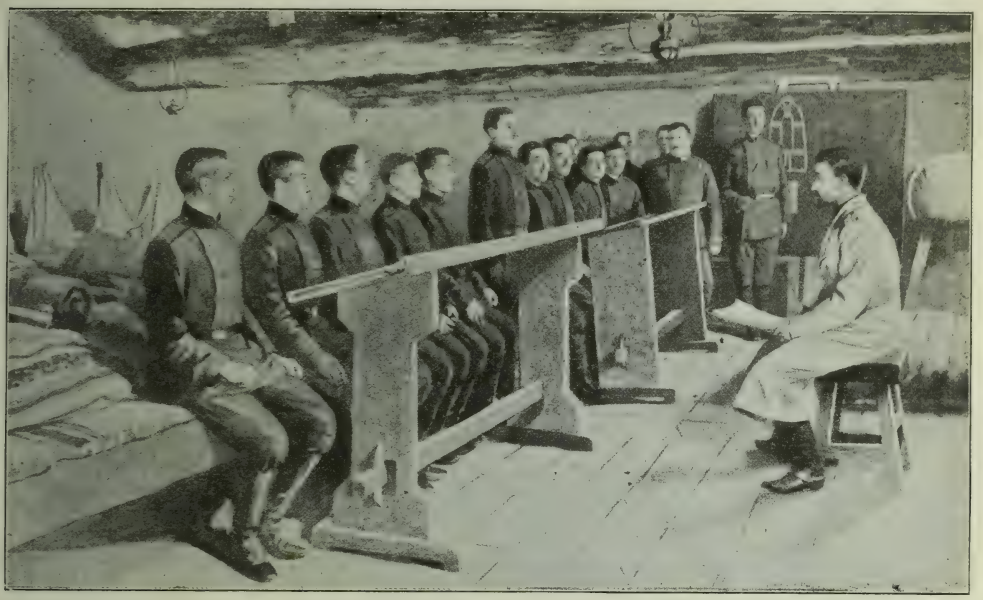
Fusan, one of the eight ports of Korea, is situated on the south-eastern coast. Until 1900 none of the ports were connected with the capital, Seoul; but since then railway connections have been granted, and much has been done towards opening up the country. The cost of the line between Fusan and Seoul was subsidised by the Japanese Government. This railway when completed will enable Japan to transport an army into the Korean capital within the space of thirty or forty hours.

the tide of Russian aggression. It is this progress of the great northern power that is worrying England and that England is determined to check before it is too late.

It is undoubtedly England's desire to force the war now, for Russia has not been awake to the plot against her. Her navy is weak and it is believed Japan could win an easy victory in a war at sea and most of the fighting would undoubtedly be at sea. While Russia, ignorant of the designs against her has been building railroads and improving territory, Japan, aided by England, has been building warships and there will be great disappointment in both England and Japan if Russia makes concessions that will avert war now when everything would indicate a Russian defeat.

Japan's fighting force at sea well outbalances that of Russia. Japan has long been busy building new warships, overhauling her old ones and equipping all of them, with English aid, with the very latest, most effective armament. The ships that would be brought together in case of conflict on the Russian side, consist of seven battleships and four armored cruisers. The battleships are of from 10,960 to 13,100 tons. Three of the armored cruisers are of from 10,960 to 12,364 tons and one of 7,800 tons.

The Japanese side would consist of seven battleships, six of from 12,517 to 15,443 tons and one of 7,335 tons; six armored cruisers of from 9,456 to 9,906 tons. The sum of the forces are 119,577 tons Russian opposed to 152,493 Japanese.



An Underground Russian Military School in Manchuria

The Russian soldier is an excellent fighting man, but, as a rule, is almost without any education, and not well trained. In Manchuria, however, efforts are being made to improve his military training and at numerous points on the railway underground military schools have been established.

In addition Russia has twelve torpedo boat destroyers and 16 torpedo boats to oppose Japan's 19 torpedo boat destroyers, 13 first class torpedo boats of from 120 to 150 tons; 36 second class torpedo boats, of from 80 to 90 tons, and 27 third class, 40 to 65 tons.

Four of the Japanese battleships exceed the largest Russian battleship, the Czarovitch, by from 2,388 to 2,743 tons.

The armored cruisers would play an important part in a war where there is such a scarcity of heavy battleships. The Japanese armored cruisers are among the most formidable in the world and are equal in fighting value to some of the heavy battleships because of the 6-inch protection to the guns of their heavy 6-inch battery.

Russia's ships can bring into action but 42 armor-piercing guns against 68 of the Japanese ships. Japan also has 214 6-inch guns against Russia's 138. Russia has in the East seven protected cruisers of from 3,200 to 6,300 tons mounted with forty-eight

6-inch guns. Japan has sixteen protected cruisers of from 2,700 to 4,973 tons mounting two 12½-inch, four 10.2-inch, six 8-inch and thirty-eight 6-inch guns. On both sides the ships are well supplied with torpedoes.

Japan's armored ships that would be brought into action in the event of war consist of the Mikasa, 15,200 tons displacement; Asaki, 15,000 tons; Hatsuse, 15,000; Shikishima, 14,850; Fuji, 12,320; Yashima, 12,320; Yakumo, 9,750; Tokiwa, 9,750; Asama, 9,750; Chen Yuen, 7,490, and the Azuma, 9,436.

Russia's armored ships that would engage in the war are: Czarovitch, 13,110 tons displacement; Retvizan, 12,700; Pobieda, 12,674; Peresviet, 12,674; Gromovoi, 12,336; Rossia, 12,200; Sevastopol, 10,960; Poltava, 10,960; Petropavlovsk, 10,950; Rurik, 10,940, and the Bayan, 7,800.

In both lists the ships include battleships and armored cruisers.

A new and mysterious craft that Russia has just added to her fleet of destroyers is the "Perr Kochka," illustrated on the front page. It is a submarine, the mechanism of which the czar's government is endeavoring to keep a profound secret. It is the queerest looking craft ever put into the ocean, and beneath the top shown in the illustration is a lot of intricate mechanism that none but Russian eyes have ever seen. Russian experts have long been working on this craft, and there is reason to believe it the most perfect and deadly submarine ever built When launched at Port Arthur it dived under the water and out again, rising and sinking at will and appearing at altogether unexpected places, much to the astonishment of the spectators and to the great delight of its builders.

The submarine has extraordinary facilities for fastening destructive torpedoes to the hull of war vessels and making its escape before the torpedoes explode. It is also remarkable for its carrying capacity. It carries a large crew besides a great weight of steel construction and underwater paraphernalia. Several of these boats are under construction by the Russian government, and they are relied on as much as the men-of-war to repel the Japanese fleet that attempts an invasion on Port Arthur or Vladivostock.

Such great secrecy is maintained in the mechanism of the "Perr Kochka" and her sister submarines that only trusted government employes were intrusted to the work of building them, and every workman was given to understand that any hint given out as to the method of their construction would be cause for capital punishment.

WEATHER FORECASTING TO BE MADE PERFECT.

Radium and Roentgen Rays May Aid Us in Knowing Today Exactly What the Weather Will Be Tomorrow

Absolute accuracy in weather predictions is promised through the medium of radium and the X-ray. When the system is perfected, according to scientists, we may know today exactly whether it will be raining, snowing, clear, warm or cold at any time during the next two or three days. This information comes in a book that has just been issued by Prof. Thompson, of Cambridge, entitled "The Conduction of Electricity Through Gases." The book records the labors of scientists who for eight years have been studying the power of an X-ray to turn into conductors of electricity for the time being air or other gases through which it was made to pass. It is this power and the conduct of the conductors when the radium is acted on by the electricity that makes possible the accurate predictions.

BALLOON FOR SAILING TWENTY MILES ABOVE EARTH.

Occupants to Ride in Hermetically Sealed Steel Shell—Londoner's Invention

Traveling in a balloon twenty miles above the earth may be possible through a craft that has just been designed by Eustace Short, of London, according to the inventor's claims. Six and a half miles above the earth is the highest point ever reached by a human being heretofore, and the greatest height ever attained by a balloon carrying self-registering instruments is 13½ miles.

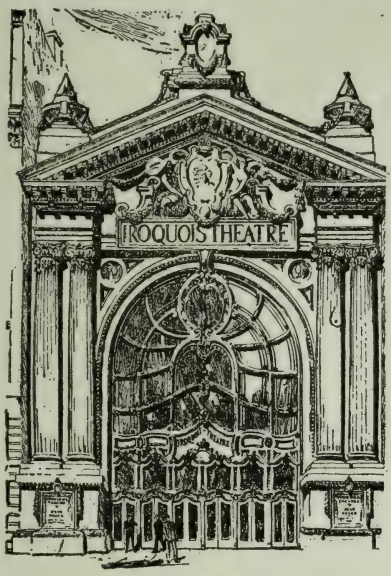
Short claims that the height of twenty miles above earth in his balloon can be attained without the accompaniment of gasping for breath, bleeding at the nose and other discomforts. The balloon car is in reality a steel ball seven feet in diametr and is filled with compressed air. The occupants will be hermetically sealed inside this spherical shell. The ballast will be carried in a cone-shaped vessel hung between the ball and the balloon. The steel of the shell will be 1-16 inch thick. Short intends the balloon for scientific investigations at great heights, and asserts it will be perfectly safe.

Popular Mechanics want ads are the best bargains ever offered for the money. Try one.

Chicagoans Gave their Lives for Our Protection

Iroquois Dead Among the Many Sacrifices Required to Rid America of Imposture

Six hundred persons died that Chicago might have the safest theaters and amusement resorts in America. Little children, school girls and mothers principally composed this human sacrifice. Their deaths will have beneficial results throughout the country, but many more lives will be the cost of substantial building construction in America, which has not yet learned that counterfeits are costly.



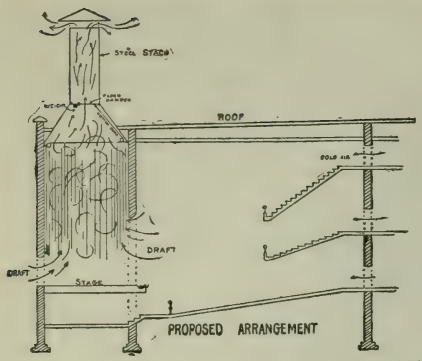
The Iroquois

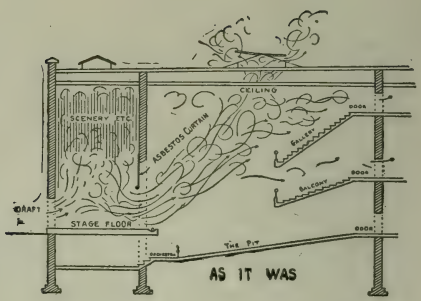
America's buildings of all classes are the least substantial of those of any civilized country. Each class of buildings is improved after lessons similar to those of the Iroquois fire. The great Chicago fire of 1871 made Chicago's business houses more substantial. The thousands of persons that are being slaughtered by the railroads are slowly causing the railroads to give us safer means of travel. Newness in America's institutions is nearly synonymous with dangerousness. Aging brings death and death teaches the lesson. It will take time and hundreds of lives to give substance to our country's structures. The collapsing of a skyscraper—they are new—will result in stronger structures than the frail shelled frames that now dot our cities.

Money greed, the ravenous desire to realize great returns from small investments, and disregard for the adage "honesty is the best policy," are the causes of these conditions that menace the lives of Americans and cause our country to be famed and marvelled at for its unparalleled disregard of human life. There were many lessons taught by the Iroquois fire, yet they were not sufficient, and many of us now living must give our lives to fully imbue corporations and municipalities with the great truth.

The Iroquois theatre, which burned with such direful results on the afternoon of Dec. 30, was gorgeously new, presenting a new fairy play, displaying resplendent new scenery and spectacles. It was a gilded void. Its management sought to deceive the public into believing it wonderfully strong, safe and expensive. They smiled contentedly at the success of their deception and chinkled their profits. The officials of Chicago, whose duty it is to enforce the building laws, sought to deceive the public into believing that they had fully inspected the theater and found it equal to all the requirements of the law, and they smiled at their successful deception and enjoyed the complimentary tickets awarded them for their ability to deceive. The man who made the "asbestos" curtain sought to deceive the public and others into believing the screen that hung in the proscenium arch was absolutely fireproof and would protect them from danger should a fire occur on the stage. His ruse succeeded, temporarily, and he laughed to himself as he pocketed the money for an imitation and thought how easily the people were beguiled. And all the way down, from the design of the building to the operation of the doors is a story of practicing to deceive, a temporary success and a final horrible failure.

The management, so elated over their successful deception, are now ruined, crushed, accursed and a hundred times rather would have spent thrice the amount in making the theatre what it appeared to be. It will cost them in money, and money was their first consideration, a hundred times the cost of the Iroquois theatre before the debt to the victims and to justice is settled. The officials who were so glad that they could elude the people so easily and get free theatre tickets whenever they desired, are now on trial for neglect of duty, and even though politics has robbed their conscience of punishing power, they must have spent in money, and money was their first consideration, many times the cost of





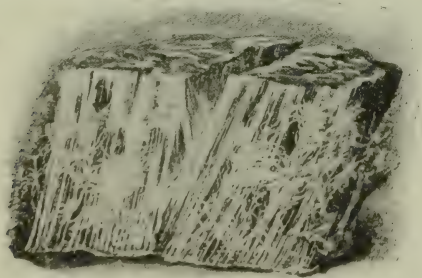
The above drawings illustrate an arrangement of theatres that would have prevented the flames from sweeping upward through the auditorium and causing such an enormous death rate among the occupants of the balcony and galleries as was the case at the Iroquois. The principal feature is a smokestack over the stage built of steel or other incombustible material of sufficient area and height to carry off the products of combustion. In a building where a sufficient area cannot be spared for a large stack the height can be increased to compensate. To guard against the weather a metal hood should be placed over the top, as shown in the design, which would be always open. To prevent escape of air when there is no fire a damper made of thin paper, secured between woven wire screens, should be placed across the lower end of the stack. It would be weighted to open automatically, but held shut by a small cotton cord passed across the top of the stage and then down to a cleat within reaching distance from the floor. In case of fire on the stage the cord could be released by a stage hand; or, if overlooked, the cord would soon burn and release the damper, which would then swing open; or, in any event, the paper would quickly burn out of the damper and the stack would instantly exert an enormous suction. As soon as the stack was thus thrown into operation there would be no more heat or smoke at the proscenium arch than in front of a furnace when the door is thrown open.

It is impossible to abolish inflamable material or lights in the stage setting for a spectacular production. Then the fire is ready to light and it is time to provide a chimney for it.

many theatre tickets, before their cases are settled. The man who made the "asbestos" curtain three parts of cotton, and chuckled amusedly at his successful imitation, now faces dismay, for his reputation has spread broadcast and he will probably never sell another, even of his real asbestos curtains. Rather now would he have given the Iroquois theatre ten pure asbestos curtains.

It was this spurious asbestos curtain, many claim. that caused the wholesale loss of life in the Iroquois.

There is a prevailing opinion among the public, as a result, that asbestos is not fire-



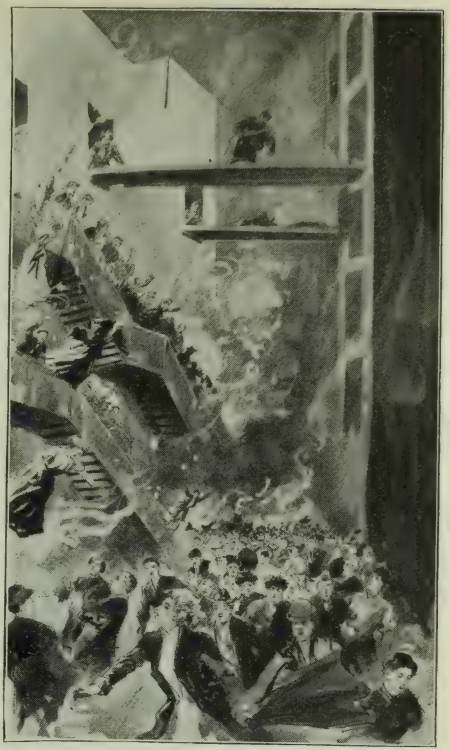
proof. Such is, however, extremely erroneous, for real asbestos cloth cannot be burned, no matter how great the heat to which it is subjected. It is cotton, sometimes mixed with asbestos, that burns. Asbestos cloth is woven mineral. The mineral, which resembles a fibrous rock, is mined in Canada, parts of the South and West and in many parts of Europe. It was known to the ancients. The finest fibrous variety is called amianthus, from a Greek word meaning indestructible. Cloth made from it was used to enwrap dead bodies placed on the funeral pile, so as to preserve the ashes of the body unmixed. The finest amianthus is found in the Tarentaise in Savoy, Scotland and several of the Shetland islands. The rock-like mineral when mined has fibrous threads clinging to it as shown in the illustration. When subjected to a rolling, mashing process it splits entirely into fibers, which are woven into cloth the same as cotton and wool are woven. Asbestos is found in layers between strata of rock. Its value depends largely upon the thickness of the layers, which are from one to three inches, the thickest producing the longest fibers, which, of course, make the strongest cloth.

The asbestos curtain has some advantages over the steel curtain, which the theatre-going public has been so loudly clamoring for since the Iroquois fire. Resembling canvas in its outward appearance it is light, easily rolled and can be handled much more

dextrously than the steel curtains. It will not burn and can be decorated as handily as any other cloth curtain.

The steel curtain, however, is undoubtedly the safest in the world, but it is cumbersome to handle. There are but four steel curtains in the United States, two of which are at the Auditorium theatre, Chicago, America's largest and most substantially constructed playhouse. The two curtains are of different sizes, to meet the requirements of the stage, which can be either enlarged or made smaller, as desired. The larger of these curtains weighs 21,000 pounds and the smaller 13,000 pounds, a combined weight of 34,000 pounds. The larger is 75 feet two inches wide and 44 feet 8 inches high. The smaller, or inner curtain is 47 feet wide and 38 feet high. They are counterweighted and operated by hydraulics, being raised straight up, like a window sash, from the floor to its resting place above the proscenium arch.

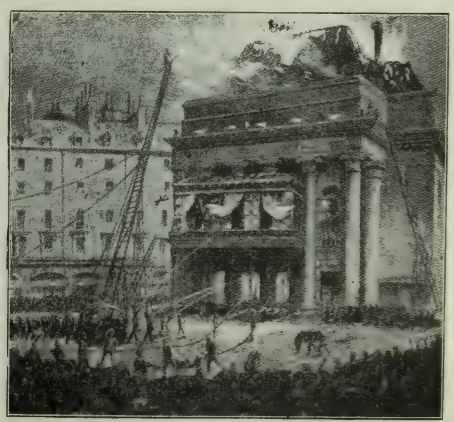
The making of a steel curtain is a hurculean task, being equal to the manufacture of a huge boiler or oil tank. First the parts of the great steel frame, composed of a larger outer frame with several cross sections, are bolted or welded together. Then the steel sheets are bolted to the frame in sections, forming one great steel plate or partition that is raised and lowered in the proscenium arch. The cross sections on which the plates are bolted are arranged horizontally and diagonally, making the curtain as firm as a wall. In the theatre the curtain is hung on steel cables and steel sheaves. The manufacture of steel curtains promises to become an important industry, since the Iroquois fire, as the public knows they cannot be adulterated, as can the asbestos curtain, and hence has more faith in them. Because of the failure of the false asbestos curtain at the Iroquois, there is a



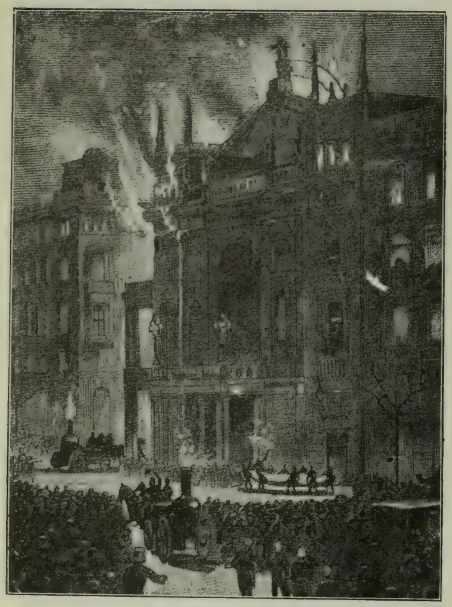
Courtesy Chicago Tribune.

The Mad Rush of Death at the Iroquis

Burning of the New Theatre, Exeter, Sept. 5, 1887—Number of Deaths 180.

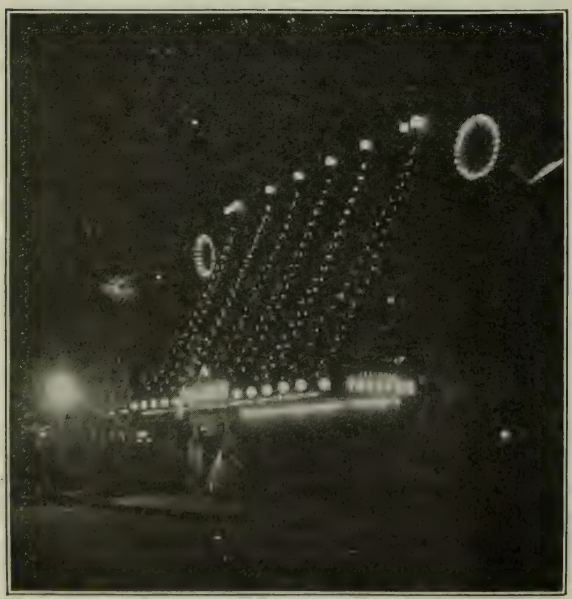


The Fire at the Opera Comique, Paris, May 25, 1887—Number of Deaths Estimated, 100



Burning of the Ring Theatre Vienna, Dec. 8, 1881.—Number of Deaths, 700.

popular prejudice against all asbestos curtains. Thus has the manufacturer of the Iroquois curtain not only damaged his own business, probably, but he has impaired that of every asbestos cloth manufacturer in the world.



The Iroquois at Night—Courtesy the Electric City.

THE TRUST THAT KILLS LITTLE BABIES.

Commercialism's Lowest Degradation Is Reached in the Antitoxin Combine.—How the Serum is Made

When it was discovered that antitoxin was nearly a sure cure for diphtheria there was great rejoicing among the little children and the mothers of America and of the world, for in this serum they had found a weapon to conquer their deadliest foe. Then came the antitoxin combine, the "baby-ki'ling trust," the meanest of them all, and raised the price of antitoxin so high that the children of the poor are denied its benefits. The result is that thousands of lives are imperiled. Antitoxin is not a patent medicine. Its discoverers gave to the world the process of its manufacture, and then came the unscrupulous greed of commercialism that would deny to little children the inheritance of their benefactor, unless they pay a fabulous sum to the trust which now has acquired a monopoly on the life-saving serum by virtue of money's power to buy. A good man gave to little children a process that would add to their chances of living. A mean man organized a trust, seeking to control this process and to charge fabulous prices to the little children for these chances of living. Fifty dollars is now the cost of giving a child the treatment with antitoxin. The manufacture of the antitoxin costs less than $8.

There are plans now, however, for cities and states to build their own antitoxin manufactories and to let the parents of little children have the serum at cost. This would save them from the power of the very mean trust and prevent hundreds of deaths. Dr. W. K. Jaques, of Chicago, and other of America's leading physicians, are advocating this plan with prospects of success.

Antitoxin is obtained from injecting diphtheria germs into animals, preferably horses, for reaction. It takes several months to prepare a dose of antitoxin. In the plant for its manufacture, in the equipment and in the scientific training necessary for the production of the serum, a large amount of money must be invested.

The horse might be called the living factory for the diphtheria specific. For the

reason that the horse is more susceptible than other animals to the diphtheria culture with which he is occulated, as well as the fact that he is large enough to produce the maximum amount of serum, he has been chosen as the subject for producing the antitoxin. The horse must not be too susceptible to the injections of the diphtheria culture, and aside from the merit of being dark, the horse should be strong enough, large enough and free from rheumatism, tuberculosis and glanders. The diphtheria to be injected into the animal is obtained from a malignant form of diphtheria in the human patient. From this the culture is made in alkaline boullion, afterward injected in the shoulder of the animal. Not only must this horse be selected with the greatest care, but after the injection he must have the treatment of a patient. In the beginning the injection may be not more than one-fourth of a cubic centimeter of the culture; in the end it may reach to 1,000 cubic centimeters.

Between this first treatment and the time of tapping the jugular vein of the horse for obtaining the serum, there are febrile disturbances, loss of appetite and, perhaps, loss of flesh. Everything possible is done to keep the animal's weight to the normal and when the creature fails longer to react after the injection of the heaviest measures of the culture, he is ripe for the tapping process. The time the horse has been under process of treatment and the number and amounts of cultures, with their malignancy, determine the "units" of serum that result from the coagulation of this blood.

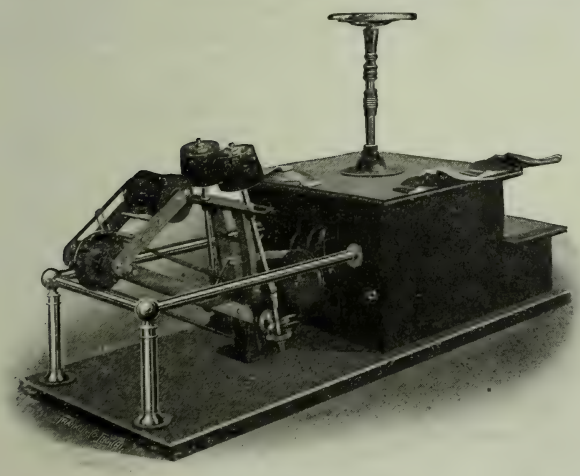
To coagulate the blood drawn from the jugular vein it is put into a jar and placed on ice. The clear portion of the blood rising to the top is the serum. Its efficiency when separated is tested by injecting a small portion under the skin of a guinea pig. The animal should die from the injections within three or four days.

The horse may be kept a subject for tapping for months, the latter cropping of antitoxin taken from his veins proving better than the first. But the strongest animals subjected to the treatment seldom live longer than two years, in which period they may have been bled a dozen times.

For the typical case of diphtheria in the human patient, the first dose of antitoxin is about 2,000 units. As to the administering of the serum a second dose should be given at the end of twelve hours if the case be one or two days old; if the case is three or four days old, the dose should be repeated in six hours, and where the case is older it should be repeated at the end of four hours. Five is the average number of doses. Seven or eight doses may be given, however, if the child's parents can afford it.

Electricity Extrudes the Bootblack

Automatic Shoe Shining Machine Arrives and Does the Work Quicker and Better than Human Hands



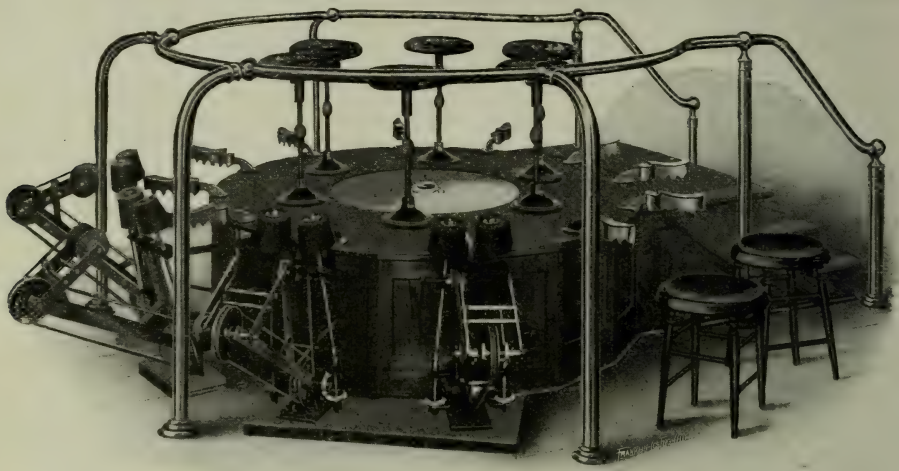
Automatic Shoe Shining Machine

Goodbye to the bootblack! He has been with us long and served us so well that we have learned to regard him as one of the country's necessary and permanent institutions. But now he must find another occupation. For the same agent that speeds trolley cars along our streets, that wings wireless words across the seas has put the bootblack out of business. The electric bootblack has come. It will shine a dozen pairs of shoes while the human bootblack is shining one.

The automatic, electric shoeshining machine is the invention of John Zimmerman of Chicago. There is an elevated platform

on which are arranged one or several stools and around which is a brass railing. Around the edge of the platform are attached the mechanical devices with revolving pulleys and little belts. The man places his foot on the footrest in front of one of these little machines when the apparatus begins to get busy. He does not move his foot until the shoe is shined. The shining is done in stages by stationary automatic machinery. The platform revolves from station to station where automatic machines perform the different operations. One of the revolving brushes rubs polish over his shoe on the same principle that an ink roller inks a printing press. Then the other brushes are rolled over his shoe while they are rapidly turning until the shoe is polished as bright as a mirror. The boy in attendance has little more to do than collect the money. The stands are made to contain one seat and shining machine or a half dozen of them, or more if desired. The machinery is operated by an electric motor underneath the platform. At present the machines are made in two sizes—the six-seated and the single-seated. The six-seated will shine six pairs of shoes in two minutes, or 180 pairs in one hour, or 1,800 pairs in a day of ten hours. The small machine will shine 600 pairs of shoes per day. At 5 cents per shine it is estimated that the large machine will earn a net profit of $27,000 per year while the single machine will net $9,300.

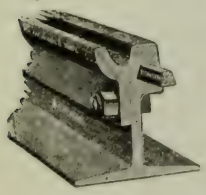
The electric shoe-shining machine is handsome in design, and simple of construction. There is no complicated mechanism, and all the parts operate smoothly, rapidly and effectively. It is of convenient size and thereby especially adapted for shoe-shining parlors of all descriptions, barber shops, shoe stores, hotels, steam and ferry boats, suburban trains, street corners and in fact any place where shoe shining stands can be found. In a few years the time-honored bootblack will have passed into oblivion.



Six Seated Automatic Shoe Shining Machine

A RENEWABLE RAIL.

The rails on both steam and street railways have to be removed and renewed when the head or top of the rail wears out. The rest of the rail is far from worn. To renew the portion which receives the wear, an English syndicate are making what is known as a renewable rail. The rail shown in the cut is a grooved girder rail, such as is used on street railways abroad. The upper part fits over the web to which it is bolted, and which serves as a joint supporter. The small bar is for "bonding" for electric roads; this bond, however, is a very poor construction.



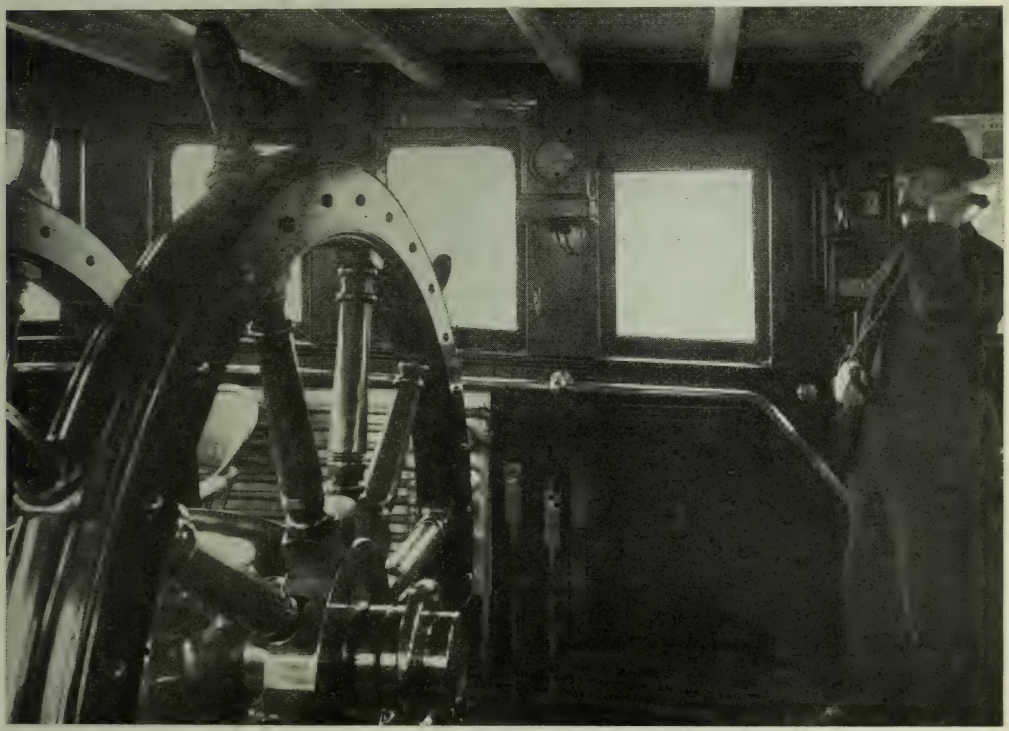
FIVE-YEAR SUBSCRIPTION.

In response to numerous requests, the publishers of Popular Mechanics hereby announce a special subscription offer of five years for $3. The address may be changed as often as desired.

Electric Ears for Ships

They Can Hear the Coming of the Submarine--Wonderful New Vessel Protection

Ships will soon have ears—ears that will hear the approach of a torpedo boat that the captain cannot see, or that will hear the sound of the fog-bell or siren on the darkest stormiest night, or that will hear the waves beating against a dangerous rock or shore the ship may be nearing. They will be electrical ears and more sensitive than human ears, because the sounds they hear will travel under water, which transmits sound far more rapidly than air. It is this superiority of the water as a sound transmitter that has brought about the new invention that may put the submarine out of business and may prove one of the greatest marine protections ever conceived.



Listening to Signals Transmitted Under the Sea.

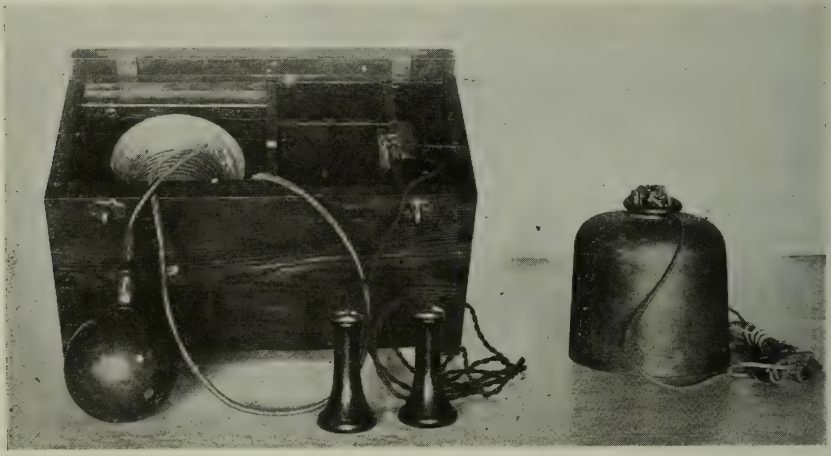
The invention is called a "sub-aqueous telephone." Its principal elements are delicate transmitters or microphones, attached to the hull of the vessel below the water line. These sentitive instruments intercept the sound waves as they traverse through the water and transmit them by regular telephone wires to the captain, who with receivers at his ears is listening in the wheel house. To aid the sub-aqueous telephone it has been proposed to equip lightships, lighthouses, bell buoys, etc., with bells that will ring in the water and thus cause the sound waves to travel at greater distance and with greater accuracy.

This system, it is believed, will enable warships to carry on telephonic signal communications with each other while at sea, no matter how dark and stormy the conditions may be above water. In averting collisions at sea it is expected to perform one of its most valued services.

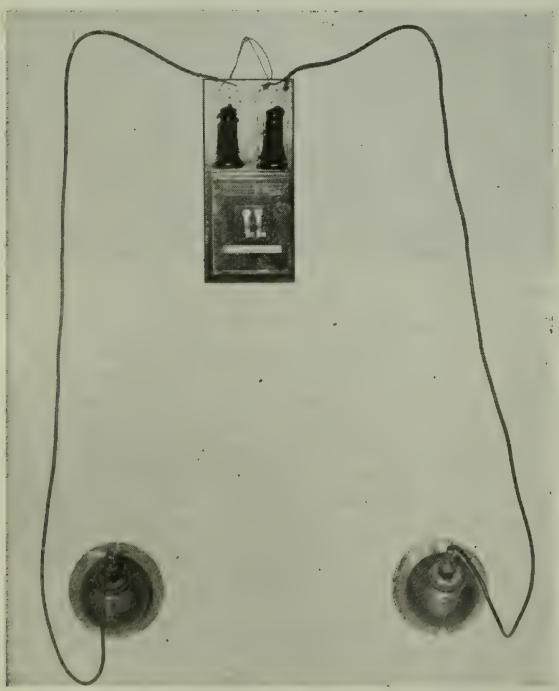
The transmitters or microphones which intercept the sound waves, are each placed inside a waterproof cup which is secured to the hull of the vessel at a considerable distance below the water line. The vessel is equipped with a number of these microphones, one of which, for instance, will be located on each side of the bow, one on

each side amidship, and one on each side at the stern.

The American Telephone Journal says: It is well known that sound waves can be transmitted through the water with as great facility as through the air, and with a considerably greater speed on account of the superior density of the transmission fluid. So if any sound waves pass through the water they will impinge upon the transmitter and can be heard in any receiver which is connected thereto. The principle of the invention realy lies in the multiplicity of transmitters which are located along the hull of the vessel and the arranging of these transmitters so that they may be successively cut into circuit with the receivers. The circuit is so arranged that two transmitters are associated with a pair of receivers which may by means of a switch (see illustration) be instantly changed from one transmitter to the other. If the vessel is approaching a coast where a lighthouse is equipped with a fog bell or a siren the sound waves produced by these will again be reproduced by similar waves in the water. These sub-aqueous sound waves will act upon and affect the diaghragms of the transmitters or microphones which will produce a current of carying intensity, which will in turn cause the receiver in the circuit to make a sound. The pilot switches his receiver successively from one transmitter to the other from bow to stern, along both sides of the vessel, and it is easy to understand that the sound produced in the receiver will be greater when it is connected to the transmitter that is nearest to the direction in which the sound is coming, and it is easy for the pilot to tell whether he is approaching a sound or receding from it, or whether it



Ball Receiver for Detecting Submarine Sounds and Associated Apparatus Arranged for a Schooner. On the Right is a Submarine Bell.



Two Receiver Cases with Connections to the Receiver Box.

is on the port or stern side of the vessel. The vibrations can be initiated by a bell that is hung over from the side of the lightship or suspended in the water, at the end of a cable, from a lighthouse, or from a bell buoy operated by the waves. The bells can be struck with a hammer exactly like a bell in the air, only with considerably more force. These vibrations are taken up by the receiver on board the vessel and transmitted electrically exactly the same as through the telephone. The ear pieces are identical with those used in the telephone. The invention does not require the captain of the vessel to use delicate telephone apparatus and tables of logarithms, but simply to use two telephone ear pieces with which to listen to the bell. In other words, the faculties that are cultivated in him are the very ones that he most uses.

A type of the sub-aqueous telephone which has been invented for fishing boats or small vessels of any kind consists of a receiving box with a ball receiver which is lowered into the water. It is obvious that some sounds would be too delicate to penetrate the skin of a vessel, and might not be heard by a receiver located on the inside. Hence it is that the receiver is lowered directly into the water and picks up sounds of comparatively small intensity. In case of emergency where a vessel is not supplied with receivers located on its hull, by lowering one of these ball receivers, first on one side of the vessel and then on the other, and noting the difference in intensity of the sound, it is perfectly practical to locate the source of the signal, whether it be the signal of a fisherman in a dory, or a bell buoy, or any other signal.

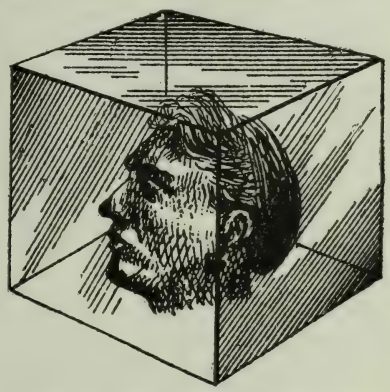
WRITING PAD FOR DESK TELEPHONE.

With the increasing use of the desk telephone has come a demand for some means of holding a tab of writing paper which will be always at hand and which will also be in convenient position for use without the necessity of being held with one hand while the other wields the pencil. The illustration shows such a device, on which a patent was granted last month.

WEIRD METHOD OF EMBALMING.

Corpses to be Encased in a Solid Block of Glass.

The strangest, weirdest method of embalming ever thought of has just been patented by a Russian residing in New York state. The corpse is to be encased in the center of a solid block of pure glass, through which the features and outlines of the body will be perfectly visible. As no air can ever possibly enter, the remains are expected to be preserved for centuries. The inventor hopes that some day a vast mausoleum of noted and gifted men will be erected, in which it will be deemed the highest honor to be thus preserved for future generations. The block of glass containing the body is to be eight feet long and of suitable width and depth. These blocks could be placed in a horizontal or vertical position, and in the course of a hundred years scores of the nation's famous writers, statesmen and soldiers would thus be assembled in a grand gallery of the dead. At least that is his plan.



Head of Corpse Incased in Solid Glass

The mechanical process which is to make all this possible, and on which the United States government has granted a patent, is quite simple. The remains are first surround with a coating of sodium silicate, or water glass, which is allowed to dry. When the water has been sufficiently evaporated, the subject is placed in a mold which is to determine the size of the glass block, and molten glass poured until the mold or flask is filled.

There have not as yet been any candidates for being thus preserved for future reference—but then, the patent was only issued last month.

The Trolley Sleeper Has Come

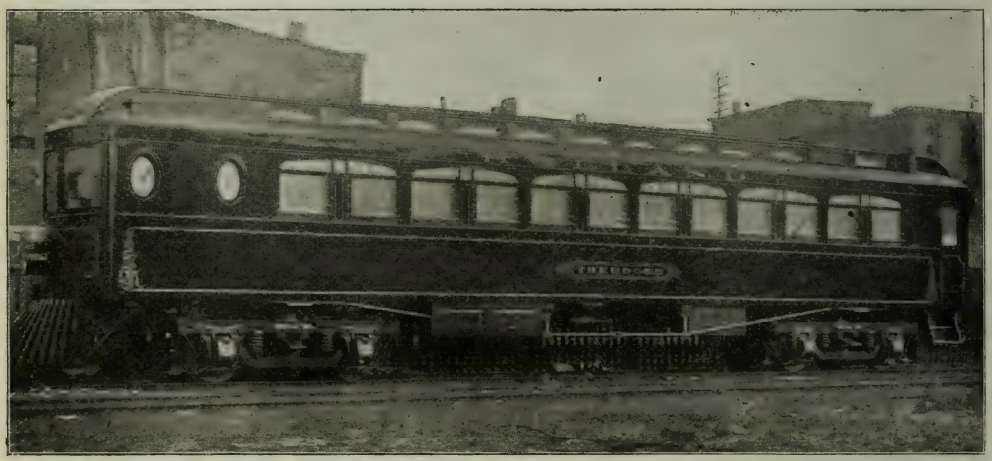
Service Beginning Between Indianapolis and Columbus is to Spread All Over the Country

Trolley sleepers have been put in service between Indianapolis, Ind., and Columbus, O. The "Indiana" enjoys the distinction of being the first of these sleepers ever built. The "Francis" was the second to reach completion and both of these are now in operation. Orders have been placed for 24 combination sleeping and dining cars. Within eight months it is expected that the service will be extended to Wheeling, W. Va., and Pittsburg, a distance of 400 miles to the east; to Cleveland and Buffalo, almost as great a distance northeast, and to Toledo and Detroit and around the Lake Erie front to Cleveland. Within 18 months, it is promised, the sleepers will be running between Chicago and Cincinnati via Indianapolis. It is the ultimate plans of the Boston capitalists, the Appleyard syndicate, to operate the sleepers and diners between August, Me., and Chicago and St. Louis. This is expected to result within three years.

In the very shops in which the first Pullman car was built, the first "trolley sleeper" came into existence. An agreement is said to have been entered into with the Pullman Company, whereby that company will not make trolley sleepers and the trolley sleeping car company will not let its space saving inventions go into the steam road service.

The trolley sleepers are being built by the Holland Palace Car Co., composed of Indiana men. The cars will be owned and operated by the company, identically the same as the Pullman company owns and operates its cars over the steam lines.

The cars will be geared to run 60 miles an hour. The smallest will have 20 berths made into compartments. The comforts of passengers is provided for even to the extent of electric hair curlers in each compartment for the women, and electric cigar



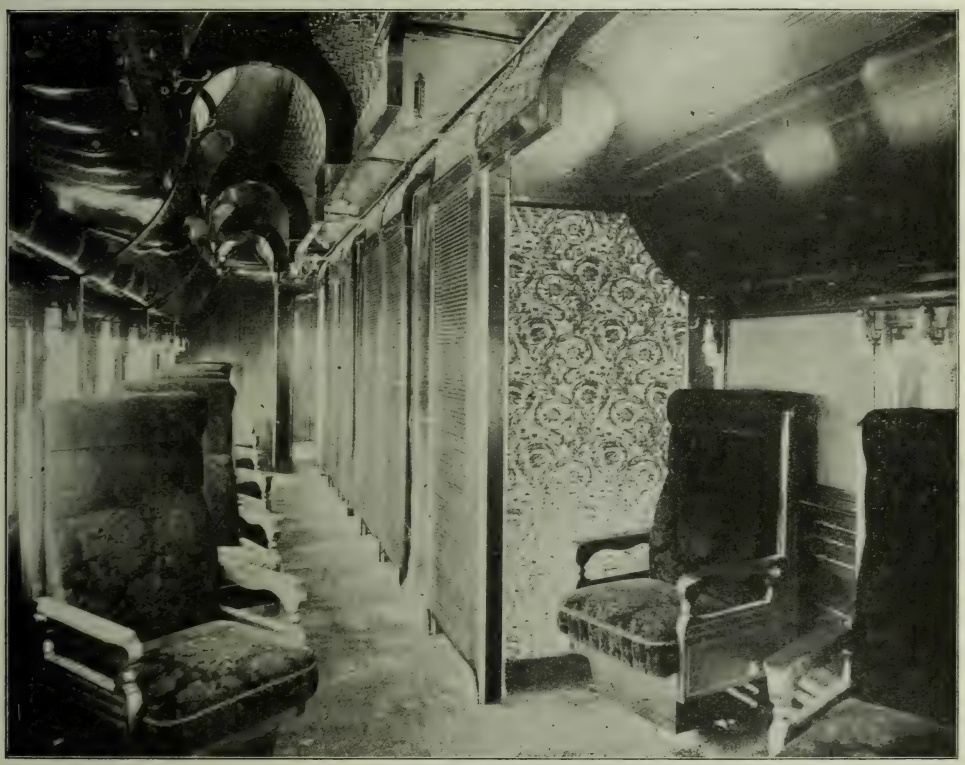
The First Trolley Sleeper

Interior View Convertible Sleeper and Trolley Car.—Day Arrangement

whereby the lights in that compartment can be "raised" or "lowered" or "put out." Each compartment is ventilated separately lighters for the men. Each compartment will be equipped with electric appliances and windows are raised and lowered by pressing buttons. When the night's ride is over all compartments are rolled into the walls and into the floors and the beds are rolled up into parlor car chairs and the car is nothing more nor less than a parlor car itself. There are large and well equipped toilet rooms for women and men. Passengens can stand while dressing and lock a door on their possessions. All berths are single, four feet wide. The combination sleepers and diners have a 10-foot compartment between the berths and the rear retiring rooms. Temporary tables are placed between chairs and the service is quite as complete and elegant as given in the steam road cars.

The compartments for the night runs are made with mahogany rolls similar to the roll tops used in desks. They come out of brass slots in the floor and dovetail into and fasten into each other when up, making a perfectly rigid and elegant wall with a doorway. The upper berth is let down from the wall on the same principle that is employed in the Pullman car.

The elegantly upholstered chair of the day parlor car is a revelation. Two of these are faced. By pressing a hidden spring the arms spread out and become part of the bed. The two chairs are made into one elegant box spring mattress-bed, four feet wide and seven feet long. The entire car can be converted into a parlor car for the day run in less than a half hour.



Trolley Sleeper Showing Berths Made Up

The Railway Review says: The car is 56 feet 6¾ inches long over buffers and 8 feet 10¼ inches wide over side sheathing. The length over end sills is 48 feet 3 inches and the width over the side sills is 8 feet 9½ inches. The clear inside width is 8 feet 2 inches and the distance from the top of the rail to the top of the deck is 13 feet 4⅝ inches. It is driven by four Westinghouse motors of 150-horse-power each, making a total of 600 horse-power per car.

When you want anything and don't know where to find it, write Popular Mechanics.

Lathe Attachments

Copyrighted 1904 by W. W. Wood.

Part I. General Introduction and Description of Divison Plate and Pointer.
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle.
Part V. Gear Wheels and Rotary Cutters.
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

PART I.—DESCRIPTION OF DIVISION PLATE AND POINTER.

In taking up the subject of Lathe Attachments and appliances my object is to put before users of small lathes a few hints which will enable them to increase the variety of work that may be done on a lathe, as for example, accurately dividing a commutator for a small dynamo cutting gear and change wheels, fluting taps and reamers, drilling holes in difficult places, cutting key ways on shafts and numerous other work such as the amateur and professional workman will find confronting him more especially if he does model making or experimental work. All of the attachments described are in use in some form or other. The subject is not a new one either, for the process of working metals by means of circular cutters, was known a century ago. Most of the small lathes in use possess a slide rest of some form and the attachments as a rule will to some extent depend upon this. The attachments will be described in such order as to enable them to be built by the user from castings or rough material at hand and if built in the order presented the attachment just finished can be used in the construction of the next in order. As a rule dimensions will not be given as each person who elects to make one or all of the attachments will be confronted with a different set of conditions, some possessing screw cutting lathes while others have only plain or speed lathes and while one may have a lathe of two inch centers, another will possess a five inch center lathe. The principles involved are the same in all cases and the user must suit the dimensions of the tool to the lathe it is to be used with.

The first attachment to be described will be a division plate and pointer, as some means of accurately dividing spaces on work held between centers, must be provided. If possessed of a screw cutting lathe this may be accomplished by using the change wheels fixed in the usual place and a pointer attached to head stock in any convenient manner. For instance a gear blank is to be divided into 40 spaces. Use the 40 change wheel. Attach the pointer so that it will drop into a tooth space. Make the cut on the blank held between centers. Release the pointer and revolve the work one tooth. Readjust the pointer and make the next cut, and so on until the job is finished. Many ways of fastening the pointer will occur to the workman. With a plain lathe a division plate is used. To make it procure a flat piece of brass 3-16 inch thick and of greater diameter than the large pulley wheel (b Fig. 1), fasten it to a wooden face plate

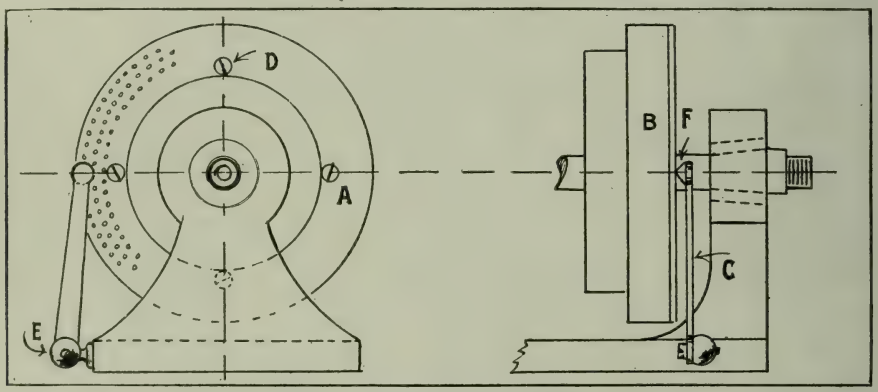


Fig. I. Division Plate and Pointer.

and, using a narrow parting tool, cut a central hole just large enough to slip over the lathe mandrel without shake. Next rough out the circumference so that you have a washer or ring a little larger in diameter than the large pulley (b. Fig. 1). Remove the large pulley and mandrel from head stock and slip the brass ring over the mandrel and flush against the large pulley. Fasten it with four counter sunk brass screws (d Fig. 1) to large pulley. Readjust mandrel and pulley, with ring attached, in head stock and, using a hand tool, finish off the circumference even with face of pulley and true up the side face of ring. Next, using a sharp pointed tool, scribe lightly three or four concentric circles on side face of ring. Remove ring from pulley and mandrel and using a pair of dividers, divide the concentric circles scribed on its side face into the number of spaces required. Use a small center punch and be sure that the spaces are equidistant from each other. The holes should be drilled with a 1-16 inch twist drill ⅛ inch deep and preferably in a small sensative drill running at a high speed. I use four sets of holes as follows: 360, 180, 112 and 96, but one row of 360 will do most of the work required. When holes are drilled the washer may be returned to its place on mandrel and secured in position with the countersunk screws (d Fig. 1), and it is a good plan to file a small notch in face of washer and pulley before removing washer to be drilled so as to get it back in its exact position. The pointer (C Fig. 1) is next made of thin steel or hard springey brass. A hardened steel cone (f Fig. 1) is made and fitted to the smaller end and the larger end is drilled to recive a screw which holds it securely to the ball show at "e" Fig. 1. E, Fig. 1, is a ball or circle turned from one inch brass rod with a flat filed in the side and drilled and tapped ¼ inch to receive the screw for holding down pointer, and a shouldered projection is screwed ⅜ inch to screw into head stock, as shown in sketch.

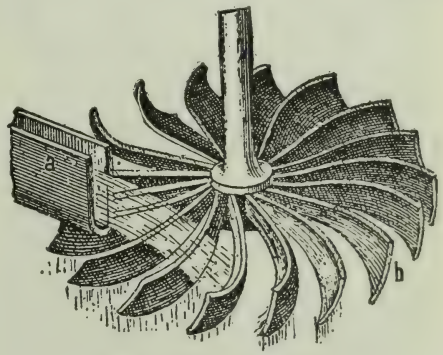
If the side face of large pulley is wide enough, the brass plate may be dispensed with, the holes being drilled in pulley.

The next article will take up overhead attachments used for driving circular milling cutters, drilling, etc.

During 1903 the United States produced $234,500,000 worth of electrical apparatus and machines used in connection with electric plants and workings. Among some of the larger items which comprise the list gathered by the Western Electrician are: Arc lamps, $1,900,000; cables, underground, aerial and marine, $19,700,000; dynamos and motors, $52,000,000; telephones and accessories, $19,500,000; wire, bare, $18,350,000; wire, covered, $17,000,000; cars and trucks for electric railways, $7,500,000; incandescent lamps, $5,400,000; storage batteries, $5,000,000.

TURBINES USED 2,700 YEARS AGO.

The turbine, of which we hear and expect so much in these days, is by no means an idea new in mechanics. Twenty-seven hundred years ago, in the little nation of the Chaldees, adjoining Armenia, the water turbine was known, and built and used in milling. It was then called the "shell wheel." The wheel was used in a horizontal position, no effort being made to secure the greatest value of the water pressure,



THE OLDEST TURBINE.

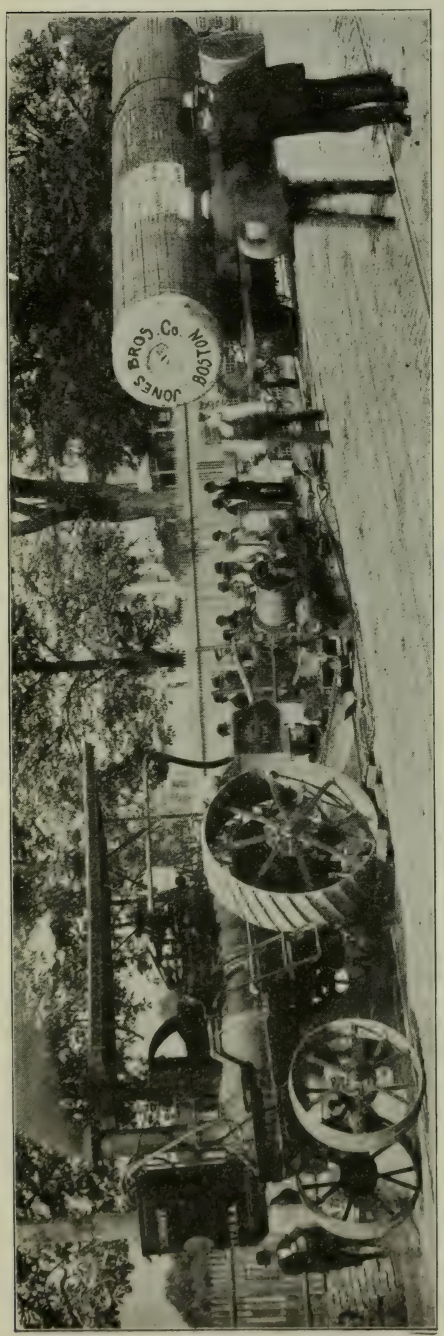
and the wheel connected to a vertical shaft which turned the stone and ground the grain into a coarse flour.

Near the city of Van, believed to have been built 2,000 years B. C., there still remain canals in a good state of preservation. One of them, 60 miles long, is now used for irrigation and power. At one time, centuries agone, there were 40 mills on this canal, and today the remains of these ancient institutions may be seen. Flour mills, driven by these simple turbines, of the same type as was used there 2,700 years ago, are still in operation.

The Deutcher Mueller, Berlin, says: "These turbines were brought to the notice of the modern world and quite generally adopted in Europe from 1750 to 1830. These Chaldees are not to be confounded with the Chaldeans of Messopotamia."

Largest Columns America Ever Saw

Colossal Granite Pillars for the Cathedral of St. John the Divine Hauled Through New York



Moving Through the Streets of New York, the Largest Granite Column Ever Quarried in America

Solid granite columns 37½ feet long and 6 feet in diameter, the largest single pieces of granite ever quarried for building purposes in America, were recently hauled through the streets of New York to the site of the new Cathedral of St. John the Divine, now in course of construction. The use of such huge monoliths in a modern building is a radical departure from existing practices and is enough to make the architect wonder if our building customs are reverting back to the times of ancient Egypt and Rome, the remains of whose constructions are yet the marvel of the world.

Eight granite columns, the most massive ever used in a modern building, are being placed in the interior of the great New York Cathedral. Each of the eight columns is in two sections, the lower of which is 37½ feet long and 6 feet in diameter and the upper 18 feet long and 6 feet in diameter. The larger sections weigh 90 tons each and the smaller 40 tons.

The original contract, according to the Monumental News, required that the columns each be made in one solid piece 63 feet long and 6 feet in diameter. Two of them were broken in turning, however, and the owners modified the contract, allowing them to be made in two pieces.

For quarrying and polishing the huge monoliths a special lathe was constructed at a cost of $25,000. The cost of quarrying the eight columns amounts to $200,000. The church they are to adorn will cost $20,000,000, and will be the most magnificent edifice in America. The hauling of the columns to the building's site marked the advent of the traction engine into city haulage. It was found impossible to transport the pilars by means of any team or combination of teams, and so a powerful traction engine was brought to the rescue. Neither was there a truck or wagon in New York or in America strong enough to bear such an enormous weight and so a special truck was constructed for the task. It is the largest and most powerful wagon ever built in America. It is capable of carrying 150 tons. The front wheels are 2 feet 11 inches in diameter; the rear wheels 4 feet 3 inches in diameter, both having a

20-inch tire of 1-inch steel, the wheels being made of 3- inch oak securely bolted together. The front axle is 7-inch square steel, the rear axle 8-inch square steel.

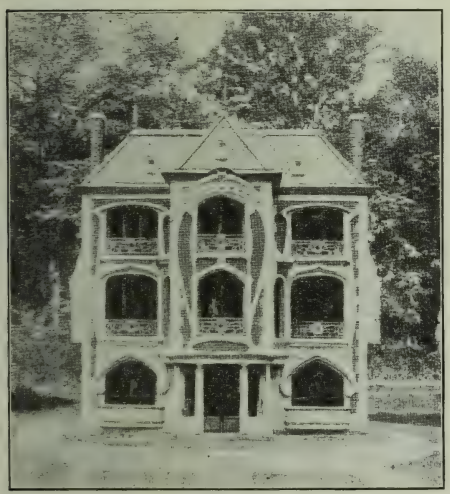
The traction engine was aided in its task by a steam winch by means of which the wagon was pulled with the assistance of wire rope, blocks and tackle.

The columns are of Fox Island granite. They were quarried and polished at Vinalhaven, Maine, and were transported to New York by water directly from the quarry, being conveyed on the deck of a lighter.

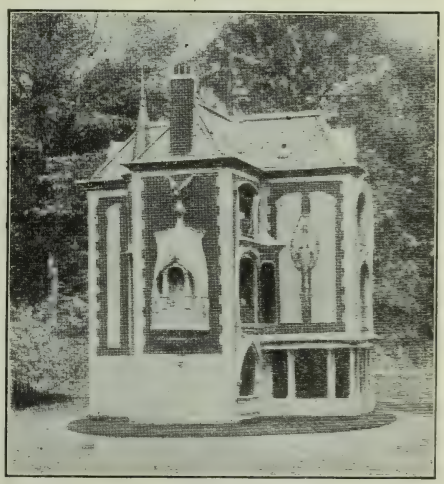
The building of the great Cathedral of St. John the Divine, which probably none living will ever see completed, was described in a previous issue of Popular Mechanics. The work has already been in progress twelve years and it may be 100 years before it is finished.

"HOUSE THAT FOLLOWS THE SUN."

A "house that follows the sun" is the ingenious conception of a French architect, M. Eugene Petit. Several of them have already been built in France. The houses



Position of the House at 11 a. m.



Position of the House at 5 p. m.

can be made to always front toward the sun. They revolve on a pivot which is turned mechanically. The principle is that of the turntable. Two men can easily revolve the house. The introduction of water, gas and electricity is ingeniously contrived.

Wireless communication has been established between Japan and Formosa.

COPY AMERICAN RAILWAY APPLIANCES.

American railway appliances are being copied in Europe and Asia. First there was a thorough test of these appliances, and they having proved successful the equipment of several important railways are to be changed so as to conform to American models. In Bavaria the government has decided to construct a large number of new locomotives after the model of approved American makes and in India the government is preparing to introduce heavier locomotives and cars, after standard American types. These are but two of a number of similar instances. It is believed that these changes will open up a larger foreign market for American manufacturers of railway supplies than they have yet enjoyed.

SIZING OF WARPS IN THE LOOM.

Loom warps that have been insufficiently sized may be so corrected in all except the worst cases without the necessity of taking the warp from the loom. A soft rope about an inch in diameter is stretched across the loom between the reed and harness, so as to rest lightly on the warp. This rope is saturated with a solution of dextrin. During the movement of the rope backward and forward the warp absorbs more or less of the solution and is thus sized and made stronger. The sticky rope picks up the loose hairs, knots and flyings from the yarn which is thus left much cleaner when passing through the reed.

Popular Mechanics

"Written So You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.

JOURNAL BUILDING, CHICAGO

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00

Foreign Countries, post paid, - - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS

JOURNAL BUILDING, : : : CHICAGO

LONG DISTANCE TELEPHONE MAIN 2682

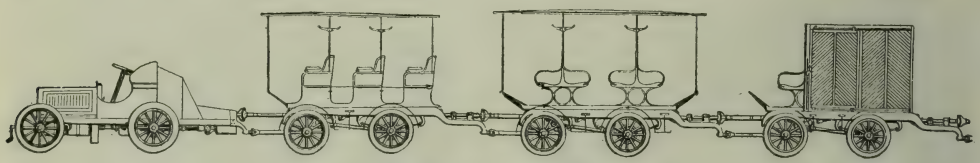
Entered at Chicago Postoffice as mail matter of the Second Clas

THE AUTOMOBILE TRAIN.

France continues to spring surprises in automobile construction and invention. Following the automobile house, described and illustrated in Popular Mechanics of October, 1903, comes the automobile train. This differs from the regulation train of steam cars, not only in requiring no expensive track on which to run, but the motor car transmits power to each of the other cars, making all of them tractors.

Under each car is a shaft extending its entire length, and connected to the car ahead and behind by a universal joint to permit of turning curves and traveling grades. The power thus transmitted from the motor car is by means of gearing under each trail car transmitted to the wheels, and thus each wheel in the entire train is made a driver. The system is known as the Renard, says Motor Age, and the motor car has a gasoline engine of 60-horse-power.

The train comprises four vehicles, the motor, two passenger, and one baggage car.



Showing Mechanism of Automobile Train.

A detachable motor and propeller, manufactured in France, can be placed in a boat and removed at will, or transferred from one boat to another.

3,000-MILE OCEAN RACE.

An ocean race over a course 3,000 miles long is now in progress. The contestants are two sailing schooners which have sailed from Providence, R. I., to Brava, C. V. I.

The Sarah A. Lee is a 74-ton fishing boat 83 feet long, carrying 37 persons in crew and passengers, of whom four are women. The other vessel, the Unique, is about the same size and has 40 persons aboard.

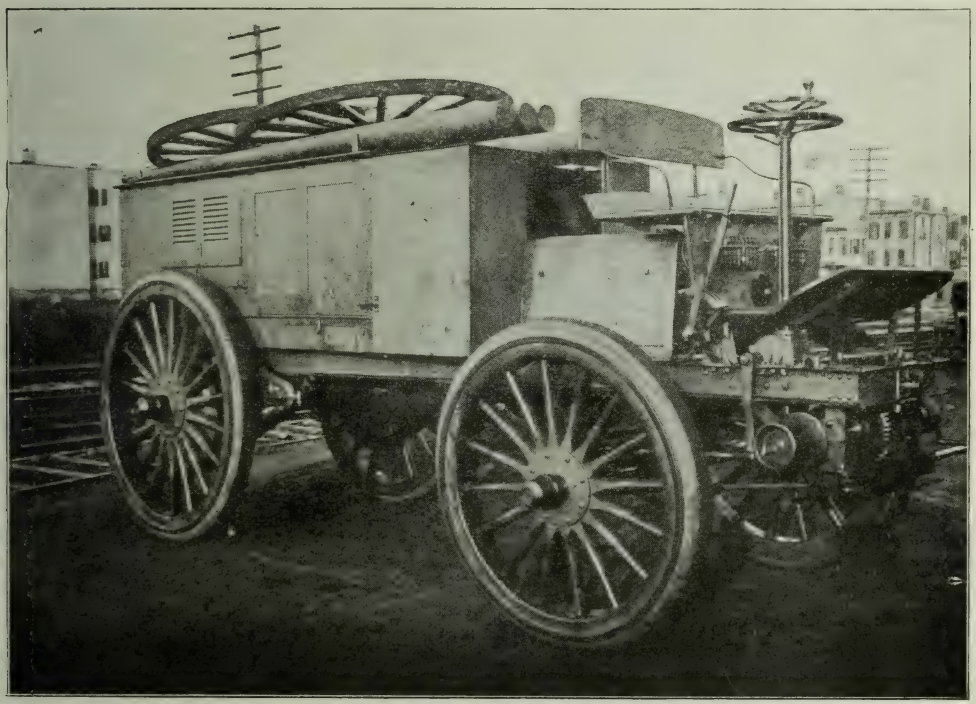
The boats will endeavor to follow the same course to the Bermudas, where a landing will be made. After leaving there each will select its own course.

First Appearance on the Streets of France of the Renard Automobile.

Wheeled Blacksmith Shop for Use in Battle

Equipped to Repair Artillery in the Heat of An Engagement and to Travel with the Army

A blacksmith shop on wheels for repairing cannon, gatling guns, gun carriages and everything pertaining to the artillery is the latest addition to the United States army. In the heat of battle, when artillery pieces become impaired from any cause, the movable blacksmith shop is ever in readiness to make speedy repairs, that the guns may quickly resume their work of death.



War Blacksmith Shop on Wheels

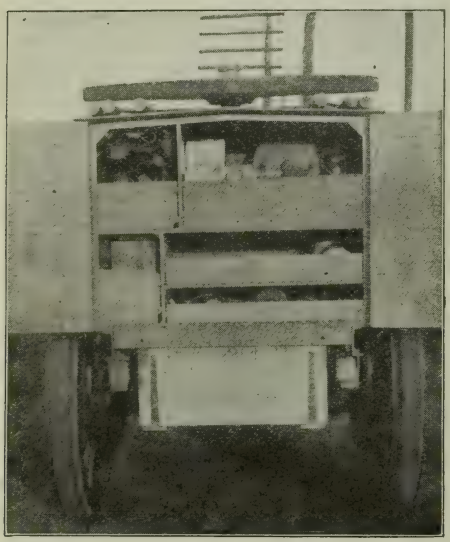
The wheeled shop is called a battery wagon. The United States is the only nation in the world to possess such an acquisition, and its service in actual warfare will be of inestimable value. In every battle that has been fought with artillery since the cannon ball's deadly work first was known, there has been a crying need for just such a contrivance, but it remained for an American to think out the conception and perfect the invention. How many times has an army been weakened through the disablement of its artillery? How many times has a general been forced to surrender because his cannon were no longer of service? History records many instances, and there are probably many more that have never been chronicled. With the battery wagon to have hurriedly placed the disabled artillery again in action history might tell a different tale in its accounts of numerous battles and it might have changed the fortunes of wars.

The battery wagon might be called an army automobile blacksmith shop. It is a huge automobile equipped with all the tools of a blacksmith shop needed for artillery repairs. There is an anvil, a forge, a lathe, emery wheel, grindstone, vice, dynamo for lighting at night and other service, and an abundance of other tools, including hammers, wrenches, files, etc.

The wagon was built for the United States government by the United States Long Distance Automobile Company. It weighs about five tons and is driven with a four-cylinder gasoline engine. The front wheels are 48 inches in diameter and the rear wheels are 56 inches. All the wheels

are fitted with solid rubber tires. The machine has four speed changes forward and reverse, and is geared to run at a maximum speed of about ten miles per hour. It is arranged with drawers and compartments to carry all the small tools and appliances.

The machine attracted great attention when it recently traveled from New York

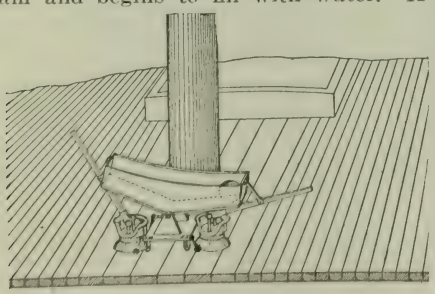


Rear View of the War Blacksmith Shop

to Washington, making the trip without a single mishap. All along the route people gathered to see it and to marvel at its unique appearance. European publications have sent representatives to America to describe the device, and the probabilities are that it will be imitated by many nations and become an established addition to all armies of the world.

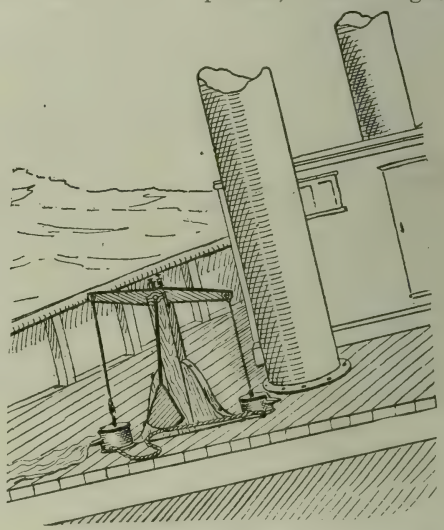
SELF-PUMPING DEVICE FOR SAILING VESSELS.

It is during a storm that a ship starts a seam and begins to fill with water. If it be a steam craft the men have only to put the pumps in motion, but if it be a sailing craft the case may be very different. In the large sailing craft now built the vessel is supplied with steam power for hoisting the sails, steering, heating, electric lighting and pumping, but thousands of older craft are still afloat where a bad leak in a storm means a battle to the death between the water in the hold and the men on deck working the hand pumps. Many a gallant crew has pumped for days only to fall exhausted and go down when a few hours more would have meant safety.



Bradley Pump

Inasmuch as the greatest need for working the bilge pumps is when the ship is rolling in a storm, G. Foster Howell, of the American Shipbuilder, New York, has invented an automatic pump, one which operates itself by gravity. The worse the storm the more it pumps. Two weights are hung to a walking beam, and as the ship rolls (it rolls more than it pitches) these weights



The Howell Pump

which are hung like pendulums work the beam which with the top of the pump is shown above deck. The pump will work in a stroke of only 2¾ inches, but will raise 60 gallons per minute. The beam is 5 feet long, and the weights 100 pounds each.

Another member of the staff of the same paper has also invented an automatic pump. It consists of a rocker 5 feet long, 12 inches wide and 12 inches deep. In the rocker is an iron ball weighing 100 pounds. The rocker is pivoted in the center and attached to the pumps. As the vessel rolls the ball rolls from one end to the other and in doing so works the pumps.

Logging in the Jungles

Menagerie of Animals and Barbaric Natives Employed About the Queer Sawmills

Lumbering in the jungles, where all kinds of strange looking animals are employed to do the hauling is an occupation very interesting to look upon, but sometimes fraught with great danger to the workmen. A veritable menagerie is often found about the sawmills in Assam, India. Elephants, yaks, zebus, Madras oxen, etc., are used to load the logs on the skidways, to load and haul the trucks and tram cars and do various other jobs of lifting and pulling. The elephant and the zebu are the most valuable of these animals. The elephant may be said to take the place of the American tram engine or "dinkey," and the zebu performs the work of the ox or mule. The natives, half clad and uncivilized, seem as wild and strange to the American tourists as the animals employed about the sawmills. In penetrating the thick, wild woods for timber, dangerous wild beasts and poisonous serpents are often encountered. The woodsmen are always armed and many thrilling escapades can be related by nearly all of them.

One of the illustrations shows a scene at a logging camp of the Sissi sawmills, of Dibrugarh, province of Assam. The clear space is surrounded by dense thickets and the logs are brought from the woods miles away. The elephants are lifting the logs onto the tram cars by means of the crude appearing crane and the native Indian oxen are hauling them to the mill. The other illustration shows the elephants and natives entering a dangerous jungle in quest of timber.

Entering a Dangerous Jungle in Quest of Timber Near Sissi

The Lumber Review, which scours all the world in its search for information regarding the lumber trade, says: "Up to a comparatively recent period timber cutters, charcoal burners, and the like, were allowed to destroy the timber of Assam much as they

pleased. The English government, at that time, devoted its energies merely to the extension of cultivation, foolishly taking no heed whatever of the waste which was going on. The Assam forest service was subsequently instituted and from that time indiscriminate timber cutting has been prohibited. The black men are forbidden to burn the jungle, wholesale, as they had done before, and every means has been taken toward securing a continuance of timber growth."

Before the action related to was taken by the English government, the uncivilized natives of Assam would set fire to miles of the jungle to drive out wild game and would entrap or shoot the animals as they fled from the flames. Great trees of the finest woods were often consumed by these flames. The largest of the trees near the settlements were often destroyed by the charcoal burners, the natives finding a ready market for the charcoal among the English inhabitants.

Log Lifting Station on the Sissi Property

LIMIT IN EMERY WHEEL SPEED

Tests made recently by Prof. Grubler of Dresden, to ascertain the speeds for running emery wheels demonstrated that no wheel stood more than 4,340 revolutions per minute. Most wheels broke into four quandrants—none into two pieces.

POWERFUL AUTO COMES OVER FROM FRANCE.

A revelation to America is the 180-horsepower racing car brought over from Paris by the American Derracq Automobile Company. The car has two four-cylinder motors, each of 90 horse power, one mounted over the front axle and the other over the rear axle They are connected in such a way that they can be run simultaneously, driving one main driving shaft or so that one of the engines can be operated to drive the car and the other left idle. Bevel driving gears are used and operate noiselessly. There are only two inches clearance from the ground and the supports of the body are in the form of skids or runners, so that when a tire bursts or a wheel breaks the car remains upright. The body of the automobile is boatshaped and so roomy that the driver can get his entire body and head down inside of it if disaster threatens. The interior of the body surrounding the driver's seat is thickly upholstered to protect the operator against bruises and possible breakage of bones.

A weighing attachment has been invented, intended to be placed in a refrigerator, and which shows at a glance how much the cake of ice weighs, either when first put in, or at any subsequent time.

Airship Factory Builds a Queer Craft

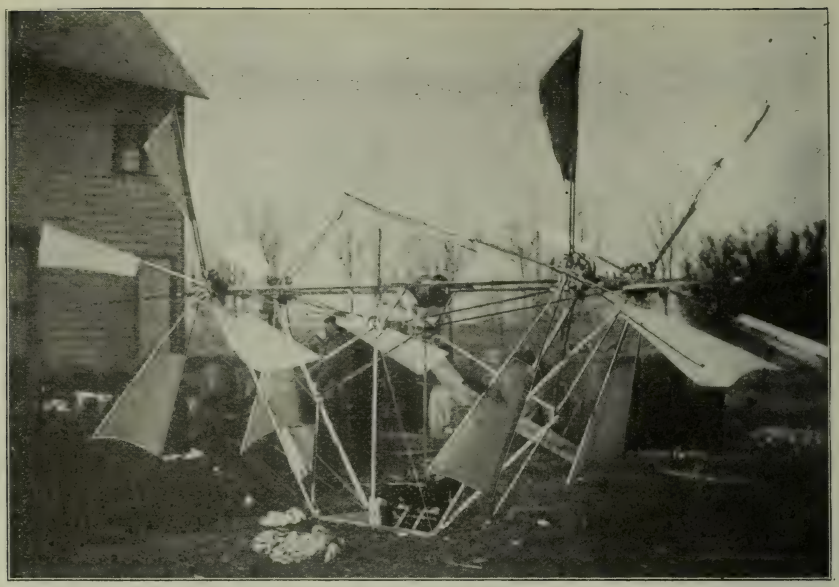
Interest in Coming Races and Recent Successes Causes Wonderful Activity in the Aeronautical World

Given impetus by the coming international aeronautical races and the recent aerial achievements in Europe and America, aeronautics enter into the year 1904 with more general interest and greater prospects of success than it has ever been able to claim before. The new year dawns on energetic airship building in many different parts of the globe; men and factories are laboring night and day, and many a mechanic and scientist is hurriedly finishing his airship plans lest some rival beat him to the goal and claim the honor of making aerial navigation practicable for all. It is the general impression among scientists that the world is on the eve of realizing the dream of general air traffic, and recent performances of aeronauts make their convictions well founded.

Side View of the Montana Airship of T. C. Benbon, as Seen at the Airship Factory—Length 74 Feet, Greates Diameter 21 Feet, Gas Capacity 14,000 Cubic Feet, Lifting Capacity 850 Pounds

Aside from the many individual builders of airships in America, a regular airship and balloon factory has been established at Frankfort, N. Y., and there many strange-looking aerial crafts are now in progress of construction. Among these are airships that will doubtless contest for the $100,000 prize offered by the Louisiana Purchase Exposition in the aerial races. One, the product of a Montana inventor, T. C. Benbon, reveals many remarkable features that may cause it to enjoy notable prominence before its career is far advanced. The Benbon airship, which is the very latest American effort, is shown in the accompanying illustration. This craft has already been tested and, though its inventor is endeavoring to keep its performance secret, it is well known that the airship demeaned itself most successfully; it was guided at will, flew against the wind, up and down and in any direction desired and was safely landed at the appointed location. By improvements and additions it is believed this device could be made to carry several

Bow View of the Bonbon Airship Inflated, in the Yards of the Airship Factory

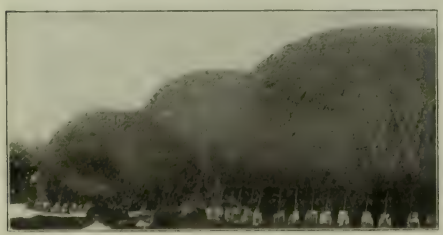


Framework, Car, Paddlewheels and 10-Horsepower Motor Weighing 110 Pounds

passengers safely. The craft is 74 feet long, 21 feet in diameter and holds 14,000 cubic

Preparing the Benbon Airship for Ascension at the Airship Factory

feet of gas. When inflated, it is said, the balloon has a lifting power of 850 pounds.



Group of Large Balloons Filled with Hydrogen Gas, at the Airship Factory

It is propelled and steered by four revolving paddle wheels whose sails open or shut at any point during each circuit to force the sharp pointed vessel upward, downward, to the left, or right, and forward or backward, actuated by a 10-horse-power 4-cylinder gasoline motor, weighing 110 pounds.

The airship factory is operated by Prof. Carl E. Myers, himself a well known aeronaut, whose recent constructions, as related in Popular Mechanics, have won wide distinction.

Air ships for the coming races are being built in San Francisco, and other parts of the country and over in Europe the interest is equally as great.

Prof. Myers has been appointed superintendent of the aeronautic grounds and buildings at the St. Louis Exposition.

Among Prof. Myers' other duties he will establish and conduct a shop in the aeronautic grounds for making repairs to balloons and airships and any new constructions which may be required. He will make and operate the signal balloons used for marking the course in the grand races, will have charge of the operation of the hydrogen gas plant and will conduct the races under the direction of the international jury. A gas plant for the manufacture of hydrogen will be built. There will be pipes and valves for the inflating of ten balloons at once. There will be a balloon testing building 80 feet high and a large structure for the use of airships.

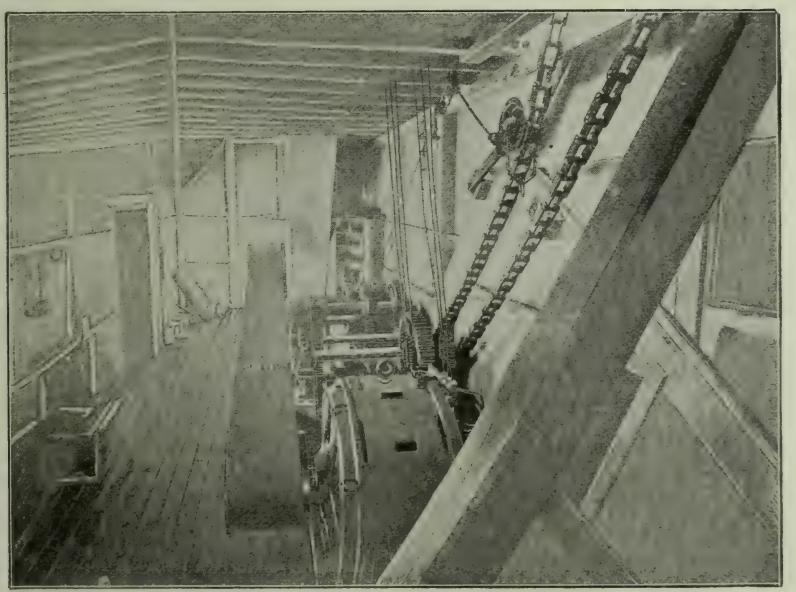
Gold Dredge Digs Wealth From Sands

New Electrical Device Sifts Out the Finest Particles of the Metal and Makes Abandoned Districts Valuable

An Electrically Operated Gold Dredge

Gold found in the sands of America's western streams is being extracted by electrical methods that are proving the vast wealth of many districts long regarded as unprofitable. The electrically operated gold dredge is the machine that is sorting out the fine dust of gold from the sands and piling it up in big paying quantities.

The electrical dredge possesses many advantages that explain its remarkable success



The Gold Dredge—Interior View, Showing Westinghouse Induction Motor Driving Dredging Buckets

in extracting gold from sand. It can be operated where fuel is difficult to obtain, which is frequently the case where gold sand is found; is works as well at night as at day, and its equipment for separating the gold is such that no particle, however small, escapes.

A gold dredging apparatus recently installed in California consists of two 180-kilowatt belted alternators, which are to be driven by water wheels; two variable speed induction motors with controllers, one of which drives the bucket line, the other the conveyor; two standard induction motors for driving the pump, one of 20-horse-power, the other of 50-horse-power, and a 15-horse-power motor for operating screens.

A gold dredge consists of the dredging machine paper and the pumping apparatus which supplies the necessary water for washing and sluicing. The dredging machinery comprises a chain of electrically-driven buckets which pick up the material, a steel hopper into which the material is emptied, a revolving screen designed to receive and wash the excavated material, an appliance for carrying off all the coarse tailings and stones that are rejected by the screens, and a sluice-box in which the water and fine material containing the gold are disposed of, and in which the gold is saved. The stone chute is of a sufficient height and inclination to discharge the material clear of one side of the boat, so that no obstruction can take place on account of the accumulation of tailings. From the under side of the screen all the fine material, including the gold, is discharged with a considerable quantity of water—all of which is carried off and over the stem of the dredge through a sluice-box containing a series of riffles, in which the gold is caught, and of a length sufficient to carry the tailing clear of the dredge to save all the gold. When the gold is of too fine a character to be efficiently collected in the ordinary sluice-box, a finer screen and gold saving tables are employed.

FRANCE TO TEST WIRELESS TELEGRAPHY.

Two wireless telegraph stations are to be established near Paris for the purpose of training Frenchmen in the art of sending and receiving wireless messages, as well as to thoroughly test the practicability of the new discovery.

WHY DO MATCHES BREAK?

Have you noticed how easily the ordinary match, most generally used, breaks? You pick one up to light the gas or a cigar, and snap! off goes the head or half the stick, leaving only a splinter in your hand. You repeat the process, and if in a hurry or a trifle impatient at the annoyance, you will likely break two or three matches before you succeed in your purpose.

Has it ever occurred to you there was any special reason for all this breakage and waste?

The old fashioned black headed sulphur match, however abominable with its choking fumes, was an honest match.

But there were no trusts then.

The matches of today are not honest, respectable matches. They are not "straight" goods. They are cut on a "bias."

When the block of wood from which they are cut is fed into the machine which makes matches by the wagon load every day, it is not fed straight with the grain, but at a slight angle. The result is a substantial enough appearing match, but there is no strength there and it will break with the slightest pressure.

Take your penknife and split a few lengthwise and see how many will split straight and true. Not many for the grain is crooked. Did you ask how this happens?

If one man breaks three matches in one day, how many matches do all the men, women and children in the United States break in a year? And every match they break creates a sale for just one more.

The homely old black match was not made by a Trust, but it was a straight, upright, well behaved match that did not fly to pieces and burn our fingers and set the house afire.

EIFFEL TOWER COMING DOWN.

The Eiffel tower, known all over the world, will be immediately torn down; that is if it does not fall of its own weight before the workmen can dismantle it. Already it has begun to lean to one side to an alarming degree, as a result of the settling of its foundations. The tower is 1,000 feet in height, and was the distinctive feature of the last Paris World's Fair. Its owners had a concession until 1910 but do not expect to be able to strengthen the tower so it would be safe to use.

Passing of the Old Type Bessemer Converters

New, and Improved Style Being Substituted--Description of the Process

The old type of Bessemer converter is rapidly being supplanted by the new Bessemer type in modern steel works. At the Minnequa works of the Colorado Fuel and Iron Company the converter that had been employed there for many years has just been demolished to give way to one of late design and improvements. The interior of the old converter is shown in the illustration. The air blast which burns the impurities out of the pig iron was turned on when the picture was taken. The blast is shown by the flames extending upward from the mouth of the vessel. The ingot molds, into which the molten steel is poured, are shown at the edge of the pit. When the metal has solidified the molds are lifted off the ingots, which in turn are conveyed to the blooming mill.

Interior of the Old Bessemer Converter, Minnequa Works, Pueblo

By the Bessemer process steel is made from pig iron by burning out the foreign impurities and replacing the requisite

amounts of carbon and manganese. The molten iron to be converted into steel is placed in a large receptacle, the converter proper. This is a spherical vessel lined with fire clay, the bottom having numerous holes, through which a powerful blast is driven during the process. The blast of air thus blown through the molten pig iron decarburizes it and converts it into steel. By this method the foreign substances—silicon, carbon and manganese—are burned out. The proper amounts of carbon and manganese are replaced by mixing the proper portion of spiegel with the molten pig iron. The molten pig iron that is poured into the converter is obtained by melting it in cupolas, called the cupola process, or by taking the iron directly from the blast furnace, called the direct process.

Converts Peat Into Coal by Electricity

New System That May Bring the Millions of Tons of Buried Fuel Into Practical Use

By William H. Mason, United States Consul-General

By a German process peat is coked in retort ovens heated by the flame of the burned gases generated by the coking process itself. This method is practically self-sustaining, produces coke of high quality, and aside from the difficulties of cutting and excavating peat under intense cold, can be worked during the winter in even an arctic climate.

At the works of Messrs. Johnson & Phillips, at Charlton, in Kent, England, there has been exhibited during the past fortnight an electrical proces for converting ordinary peat into firm, smokeless steam coal at a cost which promises to bring the product far within the price limit of steam fuel in Great Britain and Continental Europe.

The peat is cut and excavated by machinery, loaded into dumping cars which convey it from the bog to the plant, where it is packed into rotary iron cylinders of a peculiar construction. The cylinders being rotated at high velocity, the centrifugal pressure, aided by an interior beating device, expels all but a small remnant of the 80 per cent of water which the material originally contained. Electrodes connected by conductors with a dynamo are then inserted in the cylinders in such a manner that the mass of centrifugally dried peat becomes the medium through which is completed the circuit between the electrodes. The resistance offered by the peat, like the filament of an incandescent lamp, generates heat which carbonizes the material, producing a mass of distintegrated black globules, which retain all the valuable elements of the original material. This part of the process, which depends largely upon the conductivity of the peat, may be promoted by moistening the mass with certain cheap liquid chemicals, the use of which is covered by the patent.

From the cylinders the carbonized material pases to machines, which knead it into a puttylike mass, which is then pressed into briquettes or left to dry and harden in masses, which are broken into lumps, screened and graded like ordinary coal. Among the special advantages claimed for this method is the fact that the electrical current converts but does not destroy any of the valuable elements of the peat, whereas coking by fire heat expels a large percentage of these elements in the form of gases, which, being either wasted or burned as fuel beneath the retorts, are lost from the composition of the ultimate product.

Briquettes produced by this method can be compactly stowed on shipboard or elsewhere; they are practically smokeless, leave no clinkers at all, and have the high thermal value of 9,000 British units. The cost of a plant capable of treating 100 tons of peat per day is stated to be $19,500. The actual cost of producing one ton of peat fuel by this process is stated to be $1.21, equal for all steam-generating purposes to a ton of South Wales steam coal, which costs at the mouth of the mine $2.02. These are given as the economic results in a location where the electric current used by the process is generated by steam. In districts where generators can be driven within a working radius of peat bogs by water power, the cost of production would be proportionately reduced.

There are in New England and in the Middle and Western States vast beds of peat which have been heretofore left neglected as waste material in the economy of nature.

The "Four Admirals" of the Tropics

Splendid New Steamers That Carry Tourists to and from Jamaica

The Admirals Farragut, Dewey, Sampson and Schley

"The Four Admirals," as the four new steamers of the United Fruit Company's lines are termed, are splendid types of the improved passenger service that is resulting with America's constantly increasing interests in the tropics. The new boats are the Admirals Farragut, Dewey, Schley and Sampson. They are strictly "four of a kind," being identically alike in all details. The admirals are American twin-screw steamers, and each has been enlisted in the United States mail service. They ply between the United States and Jamaica, the tropical wonderland that is now attracting so many American tourists. The Admirals Dewey and Farragut ply between Boston and Jamaica, and the Schley and Sampson between Philadelphia and Jamaica. All are elegantly equipped, modern steamers and are as attractive in their artistic appearance as in the many comforts they offer.

Coal Dock Operated by Electricity

Pioneer Fuel Company's Dock Property at Duluth, Minn. One Mile of Water Front. Area Two Million Square Feet Electrically Equipped Throughout

ELECTRICITY VS. THE STEAM ENGINE

Great Coal Docks Now Use Motor Drives for General Power—Their Economy and Multifold Advantages

Electricity as a motive power is making its way into all kinds of industries for all kinds of purposes and is adding immensely to America's supremacy in the engineering arts, gained through tact in the adoption of labor-saving devices. The enormous saving in fuel consumption, lessening the loss from friction, economy of space and thousands of different applications and convenience that electricity offers over other methods of power transmission, together with the immense saving in labor, furnish the logical sequence as to why Americans are so rapidly turning to electric power transmission as the most certain factor in the accomplishment of their aims.

In a coal dock, where there is "coal to burn," it seems economy of fuel would not be an important consideration, yet many of the foremost coal yards are now adopting electricity as a motive power. The convenient manner in which the electric power can be distributed offers many advantages over a centrally located single prime mover. The electric drives are used to operate the tramways, to move all the hoists, derricks, etc., in loading and unloading the coal, to do all the repairing required, and, in fact, to run all the machinery of the immense yard. With the electric power already on hand new uses constantly suggest themselves as the mysteries of electricity are continuously being exploited and developing new uses, all to the additional economy of operating the plant.

The illustration shows one of the most perfectly equipped fuel docks in the world. It is the Pioneer Fuel Company's dock at Duluth, Minn. This dock has one mile of water front, and the yards and dock cover an area of 2,000,000 square feet. It is equipped throughout with electric motors.

WORK ON THE SIMPLON TUNNEL.

Work on the Simplon tunnel, under the Alps, goes on interruptedly with 10,000 men at work. This tunnel will be the longest in the world and will cost $14,000,000 or $1,000,000 per mile. It is expected that the tunnel will be open for traffic in 1905.

Popular Mechanics pleases all the family.

GERMANY'S NEWEST ACHIEVEMENT.

Electric Car Operated Without Converting High Pressure Alternating Current into Low Pressure Continuous

Germany has not only shown the world that a trolley car can be hurled along a track with absolute safety at a speed of 130 miles an hour, but in another test has demonstrated a great economy in the application of electric force. On the ordinary electric railway a high-pressure alternating current has to be converted into a low-pressure current before it can be transmitted through the trolley wire or the third rail to the motors of the cars. The process of conversion at various substations along the line has heretofore been so expensive as to make long distance electric travel financially impossible.

The motor used on one of the cars now running between Niederschonwiede and Spindlersfelde eliminates conversion. It derives its energy directly from an alternating current, which is carried along the trolley wire at 6,000 volts. There is no changing of current from alternating to continuous. There is no changing of voltage from higher to lower, while cost of conversion is saved.

URGE GOVERNMENT TO SAVE BIG TREES.

Government purchase of California lands growing the giant trees is being urged as a means of staying the wholesale destruction by the woodman's ax. Foremost in the movement is Captain Charles Young, acting superintendent of Sequoia and General Grant National Parks, in each of which is much land owned by private citizens. Capt. Young says the government should take immediate steps to purchase these private lands. He states: "The owners have grown tired of waiting. Where the big trees grow close to the country roads the owners have cut them down by the wholesale and put the lumber upon the market, so that where once was a fine forest of these magnificent giants there is now but devastation and ruin in the shape of stumps and sawdust piles on each side of the highroad. It is but just to the owners and for the best interests of the government that the purchase of these patented lands within the park limits be authorized by congress if the parks are to be continued."

Cost of Starting a Small Brickyard

Anton Vogt, an expert brickmaker, contributes an interesting article to Brick, the representative organ of the clay-working trade, from which we extract the following:

The extraordinary demand for clay products all over the country has turned the eyes of the big investors towards their manufacture. Statements of fabulous profits to be made in the brick business are quoted from mouth to mouth—brick can be made and loaded on cars for $3 per M. and they sell from $6 to $7 per M.; profit $3 to $4 per M. Given a yard with a 20,000 capacity per day the profit will be from $60 to $80 daily. This, of course, is on paper, and for the sake of enlightening intending clayworkers as to the actual figures on brick manufacture on a small scale we present a resumé of the equipment of the smallest kind of a brickmaking plant.

To begin with, if only a tempering wheel is used, this wheel will cost with freight about $125. Next a dozen molds must be ordered, three bricks in a mold, costing with freight about $20. While the wheel and molds are on their way from the factory, six pits must be dug, two for soaking clay, two for grinding and tempering and two for filling; these for a yard of 12,000 brick daily capacity. The digging of these pits will cost $30 inclusive of the laying of the floors, the lumber for which will cost another $54. Six hundred feet of 1-in. lumber are required for each pit at the rate of $15 per M. ft. Two carts for hauling the clay will cost $80 and a pair of horses or mules to haul and temper the clay can be obtained for about $200. Then come the smaller items; picks, shovels, axes, hammer, saw, etc., about $20 worth. Two mud barrows $10; two sand barrows $7; two molding tables and sand boxes $12; running boards, hacking planks and lumber for covering about $40, and other small apparatus about $40 more. The harness and feed for the mules can be figured at $75. This makes a total of $693 for the outfit and then about $300 must be in hand for operating expenses. Briefly stated, then, no one should figure on embarking in the brick business on no matter how small a scale with less than $1,000.

Now let us figure how much it will cost per M. to make the first kiln of 100,000 bricks. Supposing the clay is bought at 25 cents per M., digging the clay, filling and tempering will cost 70 cents per M. inclusive of horse feed. Molding will cost 30 cents per M.; mud wheeling, 25 cents per M.; off-bearing with three boys, 30 cents per M.; hacking in the yard, 10 cents per M.; loading to the kiln, 20 cents, and setting, 15 cents per M.; casing the kiln, 5 cents per M. Coal or wood will cost $1 per M.; labor for firing, 25 cents per M.; loading in cars, 25 cents per M.; a total of $3.80 per M.

So far the figures would seem to show a fair profit in the brickmaking business, but the brickmaker has both an ally and an enemy in the weather department.

Suppose 12,000 bricks were molded today and ruined during the night, then the next 12,000 would cost twice as much or $7.60 per M. There would be simply no profit at that price and that is the figure which many bricks cost, less the setting and burning. One case in particular can be quoted where 200,000 bricks were made and the labor paid for and only 101,000 were set in the kiln on account of unfavorable weather conditions. Of course this 101,000 cost more by the time they were burned than their market value. These things happen in open yards without any shelter. It is, therefore, not advisable to make any bricks by any process without providing a suitable shelter for them after they are made. Six thousand bricks per day under shelter will bring more than 20,000 bricks laid out in an open yard at the mercy of the weather, but this sheltering costs money to erect, and this additional cost must be added to the sum estimated for the equipment of the yard as first mentioned. There is money in the brick business if the enterprise is managed right, but not so much as the amateur imagines or as the skillful manipulator of the black pencil on white paper is able to show.

This country is filled with brickyard graveyards.

A new material for joining pipes is called "leadite," because it replaces lead in many ordinary uses.

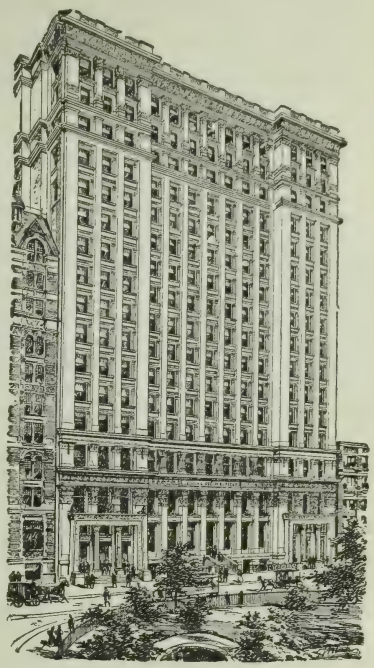
In Wisconsin a roof covered with sheet zinc in 1854 is still in fine condition and has never cost one cent for repairs.

Great Buildings of America

New York Structure that Reaches 380 Feet Above Ground and Contains 1,160 Offices

Thirty stories high, rising 380 feet above the sidewalk, and containing 8,000 tons of steel and 8,000,000 bricks in its construction, the Park Row building, New York, is the tallest and vies with the Monadnock building of Chicago in being the greatest office building in the world, despite claims made for newer structures. It towers like a great monument above the skyscrapers of New York city and is one of the first sights of the metropolis to be viewed by passengers of incoming vessels.

There are 4,000 piles supporting the structure, the foundation of which covers an area of 15,000 square feet. The foundations are carried 75 feet below the sidewalk to bedrock. First come the piles driven down forty feet. On these rest the grillage beams, which cross and recross one another, forming a firm foundation for the great piers. These are like so many backbones, extending from foundation to roof, sustaining the entire weight—walls, floors, everything. There are 2,080 windows looking out on the streets of New York, and 1,770 doors in the building. The exterior walls of the building are covered with 15,000 square yards or 3 1-10 acres of paint, and there are 16,000 square yards of paint on the steel frame. The structure is lighted with 9,500 electric lights. Power is furnished by three boilers of 900 horsepower. Ten passenger elevators carry the occupants to and from the 1,160 offices in the building.



The Highest Commercial Building in the World

ELECTRICITY FOR NOTHING.

During the recent electrical storm in the Northwest the telegraph wires developed some strange freaks. With all the batteries on the line cut out, the operators were able to telegraph between St. Paul, Minn., and Dickinson, N. D., a distance of 650 miles, by the earth currents. The American Telephone Journal says of the phenomena.

"Magnetic storms almost invariably occur during any period of solar disturbances, and just about the time of the recent Aurora disturbance, a group of unusually large sun spots made their appearance and slowly drifted across the disc of the sun. It has been so far substantiated that there is an intimate connection between solar phenomena and the magnetic condition of the earth that there is little doubt of the possibility of sending signals across inter solar space, and so Mr. Tesla's famous idea of signaling Mars is not theoretically impossible. The only difficulty seems to be to get an electric generator big enough to cause a disturbance great enough to be felt at so remote a distance.

Architect Siegwart, of Lucerne, Switzerland, has patened a new system of concrete flooring, consisting of hollow tubes of mortar and iron.

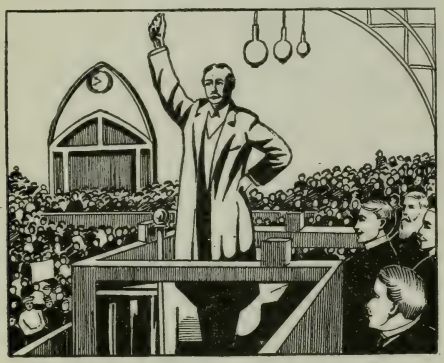
A Pittsburg concern announces an iron pipe which cannot be burst by freezing.

Popular Mechanics "is written so you can understand it."

ELECTRIC EARS REACH FAR.

Theatre, Opera, Lectures and Church Service in the Home

The English have certainly out-classed us in many of the utilities of the telephone. While we in America have talked about its possibilities our European friends have put the theory into actual practice.



Mr. Balfour Speaking While Telephones Transmit His Words Miles Away

In all the leading hotels, clubs, and many of the mansions of London, the guests or occupants have only to place the telephone receiver to their ears to enjoy the best entertainments in the city. It is even proposed to connect the House of Commons to the service so that all London may listen to the debates in parliament.

Thus far little attempt has been made toward a long distance service, but a recent test was so satisfactory there seems to be great opportunities. The time may not be far distant when the English traveler in San Francisco may listen to the prime minister as he addresses the House of Lords. The test mentioned was on the occasion of the speech at Sheffield by Mr. Balfour in which connection was made to the telephone company's office in London, and 24 journalists listened to the entire address. All took notes and several even made verbatim reports in shorthand.

Londoners Listening to Mr. Balfour's Speech Spoken at Sheffield

Toward the close of the address the speaker's voice became tired and many of those in the audience were unable to hear him. He apologized for not being able to make himself better heard, but miles away, sat the group of reporters who did not miss a word.

Four transmitters were placed around the speaker, upon an improvised hand rail so that in whichever direction he faced there was at least one transmitter to catch the speaker's words. These transmitters were all connected to the same long distance wires extending to London. A double receiver, one for each ear, was provided for the listener at the receiving end.

THE MACHINIST MUST BE A SPECIALIST.

The writer (in Locomotive Engineering) was in a railroad repair shop recently when the division superintendent brought in a typewriter to be fixed—said it was out of kilter. The foreman looked at it, struck a key or two, and remarked: I don't know much about these things." "Why," exclaimed the superintendent, "you have the reputation of being the best mechanic on the road; I thought you were just the man." The foreman turned to the speaker and said: "I am a locomotive repair machinist, and have carefully studied it for fifteen years; if you will bring me any job on a locomotive that I cannot do that any other mechanic can, I will resign, but life is too short for a man to spread himself out so thin as to attempt to be familiar with all classes of machinery. There are men who make a specialty of typewriters, as I do of locomotives. They can repair that machine in half the time, for half the money, and twice as well as I can. I would be as foolish to attempt to put new letters on that machine as the maker of typewriters would be to put a new tire on a locomotive."—

The proposed electric equipment of the Grand Central Passenger Station, New York, and the lines running into it for fifty miles, marks another victory for electricity in the fight it is waging with steam for the motive power of the railroads of the world.

America's Highest Mountain Peak

Mount Whitney, located in the Sierra Nevada mountains, Kerns county, Cal., has very recently been scaled, and a careful official measurement made of the altitude of that kingly peak.

The measurement was made by Professor McAdie, chief of the United States Signal Service, at San Francisco, and one of the faculty of the University of California, and Prof. Joseph Le Conte, also of the same university. From careful experiments it was ascertained that the altitude of this great mountain is 14,522 feet above sea level.

That determines that the apex of Mount Whitney is the highest point in the United States. The next highest peak is Mount Shasta, located in northern California, being 14,460 feet. The third peak is Mount Rainier, in the state of Washington—14,444 feet. Any one standing on the dizzy pinnacle of Mount Whitney can truthfully assert that he or she has stood on the "highest point in the United States." The ascent of this great peak is attended with many difficulties, much toil and no little peril. Only of recent years has it been ascended. Some days are required to make the trip to the summit and back to the haunts of civilization. The road, and latterly the narrow trail, lead over and through a most rugged, wild and precipitous region—through the very heart of the vast Sierra Nevadas.

During the past summer several parties have made the ascent of Mount Whitney. These parties have gone from San Francisco. The most notable ascent of this great mountain was that made by the famous "Sierra Club" of California. That ascent was made during the latter part of last August. The members of this club were gone about three weeks.

Mr. McAdie and Joseph LeConte Taking the Altitude of Mount Whitney, July, 1902

The crest of this peak was reached without accident, though not without great toil, hardship and danger; the descent was made with much less labor and peril. Among the party were a number of women. Notwithstanding the long and fearful climb, the women stood the trip remarkably well.

The photo shows Profs. McAdie and Le Conte with their instruments figuring out the exact altitude of Mount Whitney. Owing to the prevailing atmospheric conditions, no clearer photo could be secured. After computing the height of this vast snow sentinel, Prof. McAdie waved to the breeze a small American flag as a token of the triumph achieved. That was the loftiest point in the United States from which the Stars and Stripes have ever been unfurled.

A letter has recently been received here from George E. Hale, of Chicago, secretary of the Commission on Observatories, stating that a Carnegie observatory will be built on the summit of Mount Whitney. The building is to be 103 feet long and 30

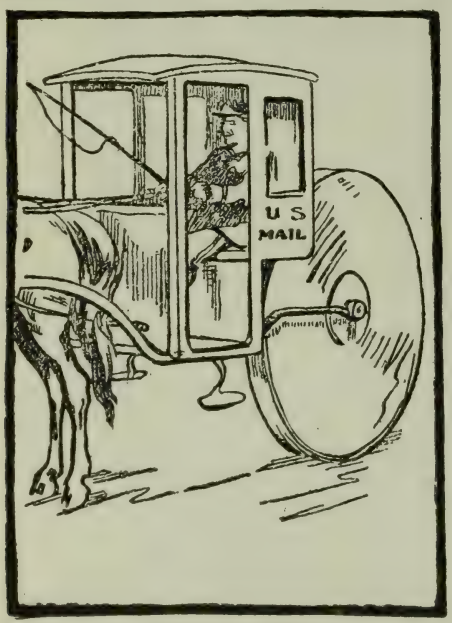
feet wide, with a porch extending around it, and be constructed of granite. All the equipments will be of the very latest type.

From the pinnacle of this peak the view is one of incomparable grandeur and surpassing beauty. It is a vision of glories never to be forgotten during a lifetime.

INVENTS A ONE-WHEELED WAGON.

Now comes an Illinoisan who tells us there is no use in having more than one wheel to light vehicles. The one-wheeled vehicle will maintain its equilibrium just as well, and is especially adapted for muddy roads, the inventor says, principally because after the trip there is just one wheel to clean instead of four.

To demonstrate the merits of his conception this Illinoisan has built a one-wheeled rural free delivery wagon. He has shown that it makes its way through mud with comparative ease and wants the United



One Wheeled Mail Wagon

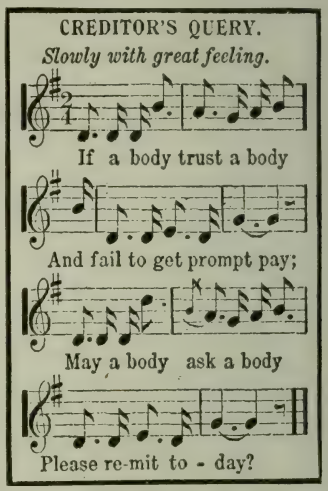
States government to adopt it for the rural free delivery service. The wheel is flat and without spokes. The vehicle is hauled by one or two horses.

British manufacturers appear to be steadily losing ground as regards agricultural machinery in Russia, says the Mechanical Review, of London, while America and Germany are continually increasing their outputs to this district.

DUNS SET TO MUSIC.

"Song of the Collector"—New Way of Coaxing Payments

"Coming Through the Rye," that delighting old song, born of the genius of Robert Burns and immortalized by prima donnas and hand organs since, has at last met its doom. Hereafter when we hear "Coming Through the Rye" we will feel like going


CREDITOR'S QUERY.
Slowly with great feeling.
If a body trust a body
And fail to get prompt pay;
May a body ask a body
Please re-mit to - day?

through the window for we will be reminded of a dun. Yes, the latest thing is a dun set to music, and "Coming Through the Rye" is the official "please remit" air that has been chosen.

A Chicago musical firm are the desecrators who have brought the ignominy on the time-honored air, but it has brought money into their pockets. The firm found there was no use in trying to force people to pay; it was not good policy to scold delinquents; gentle urging did not avail and so they devised the plan of singing to them by mail; that is, sending them a song with words and music gently entreating "remittance." The words are something of a rhythmical version of the song the collectors long had to sing in trying to get action on the debtors, but anyhow instead of their singing the same old song from the bill book it was decided to have a real song written and sent to the slothful payers, one that they had not heard the collector sing each month at the door and, while familiar, one that many of them would not so readily recognize.

Hereafter look out for bull dogs and shot guns when you serenade your girl with "Coming Through the Rye," especially if her papa bought her piano in Chicago.

Tearing Down Egypt's Temples

New Population is Playing Havoc With the Old and Hallowed Ruins

Voices of protest are sounded manywhere over the increased demolition of Egypt's ancient buildings that has resulted since the completion of the great Assuan dam. The resurrection of Egypt that has come with the curbing of the waters of the Nile to flood the desert land has caused the hurried influx of a heterogeneous population that has little regard for sacred edifices, save to tear them down for relics, and Egypt's temples and walls are now being destroyed faster than they ever were before except by an invading army.

The temple at Luxor, in ancient Thebes, whose columns have withstood the foeman's steel for 3,400 years, is now succumbing to the peaceable invasion of the age of commerce. The columns are being broken up and every ornamentation that can be detached is ruthlessly torn away. The temples at Luxor and Karnack were the largest and finest in Egypt, and are said to have covered 1,000 acres on the eastern side of the Nile. They were the pride of ancient Thebes, which once boasted of 100 gates and 20,000 chariots, and was the largest and finest city in the world.

Ruins of the Temple of Luxor

A contributor in the Monumental News, in a recent description of the ruins of Egypt, says: "The columns of the temple at Luxor are especially fine and were better preserved than most of the others. There were several large statues of Rameses and seventeen large statues of his sons. One thing that impressed me was the way the old walls were built where it took several stones to make a course. The beds and joints were laid stone to stone and each joint was clamped with wooden clamps. They were 10 inches long by 3 inches long at ends, 2 inches in the middle and 1 inch thick. I saw a socket of wood in place that held the top pivot of a door that was apparently as sound as ever. Everywhere there was evidence of fresh demolition."

HE NEEDED IT LATER.

At Cornell all the mechanical engineering students have to learn seven trades. One of these trades, that of blacksmith, is very distasteful to some of the students; but it has to be learned all the same. One young fellow, who was unusually averse to soiling his hands, begged hard to be exempted from wearing the leather apron; but the professor took special care that there was nothing lacking in the thoroughness of his training at the forge.

Last fall the student went to the professor and thanked him for being compelled to learn blacksmithing. "You see," he said, "I am now superintendent of a mine away back in Colorado. Last summer our main shaft broke and there was no one in the mine but myself who could weld it. I didn't like the job, but took off my coat and welded that shaft. It wasn't a pretty job, but she's running now.

"If I couldn't have done it, I'd have had to pack that shaft on mule-back and send it three hundred miles over the mountains to be fixed; and the mine would have had to shut down till it got back. My ability to mend that shaft raised me in the eyes of every man in the mine, and the boss raised my salary."

An Endurance Run in Truth Was This

Terrible Experiences of Men and Machines in the Remarkable 1,000 Mile New York to Pittsburg Test

Narrow escapes from drowning, thrice barely saved from being dashed down slippery mountain sides, exhaustion from hunger, sleepless nights and inhuman exposure—this is the story of the 1,000-mile automobile endurance run given by the National Association of Manufacturers. It was "endurance" almost beyond "endurance" throughout the remarkable expedition. Such another was never experienced before, and will never be experienced again by those who escaped the hazards, so they declare.

Two Cars Caught in the Susquehanna River Flood

The run was from New York to Cleveland and thence to Pittsburg, over a route specially selected by the promoters for its perils. Floods, thunder storms, washouts and numerous unlooked for catastrophes added to the distress of the men and vehicles. The automobiles at times were forced to abandon the road and take to the railroad tracks; they had to be hauled out of flooded districts by horses. Often the automobilists were up to their necks in water. The men proved to possess more endurance than the automobiles, as when the perils were at their height the automobiles stalled in the middle of streams, and the men had to wade out in the water and pilot them across. In one of the cars a can of carbide was ignited in a flood which nearly swept the vehicles from their path near Binghamton. The flames burst all over the car, creating almost a panic and seriously injuring the operator, who in consequence was forced to abandon the run.

These extracts from the Automobile's description of the run may give an idea of some of the other "endurances" encountered: "The jolting over the railroad tracks had loosened every electrical connection. Again our engine stopped, and for four hours we were looking for a spark. During this four hours the writer availed himself of the first opportunity in the last 48 hours to lie down by the side of the road under a tree and get nearly two hours' sleep. We covered 447 miles in 47 hours, with only six hours' sleep on the part of the operator, and no sleep from Saturday until Friday night on the part of either passenger or observer in our wagon, except such as we gained while sitting in the wagon.

"Horses refused to draw in our efforts to get out of the flood near Binghamton. For an hour and a quarter the operator, in water up to his waist, and sometimes above his shoulders, tugged away with the second horse. A rope 200 feet long was secured, and finally bystanders on the railroad track

succeeded in pulling the car back to its original starting place. From there it was towed back five miles to Binghamton. There new batteries and new coil were secured, and we obtained dry clothing, having traveled in wet clothes for 96 hours."

The greatest of the perils were encountered in crossing the Susquehanna river and the Allegheny mountains. Miraculous escapes from total destruction were many. There were twenty-five automobiles in the run. Sadder, more dilapidated looking equippages were rarely ever witnessed than the automobiles and riders when the vehicles, one by one, straggled into Pittsburg.

SUGAR FACTORIES ON IRRIGATED LAND.

Will the reclaimed land of western America develop into a great sugar district? This is the question now being asked by many irrigation enthusiasts and agriculturists. The success in growing the sugar beet on irrigated land of the west is such as to cause most flattering promises. The sugar beet seems to thrive on irrigated soil and to possess a commercial value from the sugar it contains that beets grown elsewhere cannot rival. Sugar factories have sprung up in many sections of the west as a result and they are doing a big business. The illustration shows a pile containing 60,000 bushels of beets awaiting shipment.

Hundreds of Carloads of Sugar Beets Dumped on the Ground Near a Western Sugar Factory

CUTTING TREES WITH COMPRESSED AIR

Many of the lumbermen in California are using compressed air in felling trees, and the method, which is the invention of a railroad man in Oregon, is said to greatly reduce the expense of hand work. Indeed it bids fair to displace axemen to a large extent.

The outfit consists of a traction engine carrying a compressed air reservoir, with long rubber tubes connected to the latter, and each of which has a pneumatic engine sawing attachment at its other end. These tubes are extended out to that part of the woods where the gang is working, and drives great cross-cut saws at a terrific rate.

One of these saws will, it is said, cut through a pine tree five feet in diameter in five minutes, whereas the same work done by two men consumed at least one hour. When the trees have been felled, two or more men are set to work cutting them into logs in the same manner.

Manufacturing Dynamite Bombs

Secluded Abodes Sought by Macedonian Insurgents Engaged in this Dangerous Work

Dynamite was one of the principal weapons employed by the insurgents against the Turks during the Macedonian insurrection. Many people were engaged in the manufacture of dynamite bombs, which during the uprising became quite an industry in Macedonia. Secluded dugouts, caves and hidden habitats of the mountains were sought by the bomb manufacturers. A photograph showing the insurgents engaged in manufacturing bombs in one of these mountainous recesses has been forwarded to Popular Mechanics by an American tourist, from which the accompanying picture is reproduced.

Making Dynamite Bombs

LIQUID FUEL FOR ROUMANIAN STEAMERS.

Le Yacht, of Paris, says: The management of the Roumanian state railways have finally decided on fitting all their steamers running in conjunction with their lines with liquid fuel burning apparatus. This decision is due to the splendid results obtained in the test of liquid fuel on one of their steamers. Calculated on a basis of the fuel consumed during 135 journeys between Constanza and Constantinople the saving effected has been estimated at 40 per cent.

A WATER WHEEL PROBLEM.

Editor Popular Mechanics:—Please let me call your attention to a little matter here that is contrary to teaching:

We have an irrigation canal here in which runs 70,000 gallons of water per minute. We have put some 16-foot under-shot water wheels therein to raise water to a higher point. We find that a wheel 16 feet in diameter and long as the ditch is wide, which is 12 feet, and 20 inches in the water, will raise 250 gallons of water per minute 25 feet high. We find that four of these wheels working in a 70-foot space in this ditch each raise 250 gallons per minute and do not raise the water in the ditch (that is, do not back it up and make it deeper above the wheels). Since one wheel does not bank up the water we were inclined to believe that a number of wheels would not do it. Since the four wheels do not bank up the water and each has the named power for raising water, we believe that should the ditch be placed full of wheels the water would go through just as rapidly. This being true, we could put three hundred 16-foot wheels in a mile of this ditch and have a little leaway to spare. These three hundred wheels would raise 75,000 gallons of water 25 feet high each minute, while it takes fourteen minutes for the 70,000 gallons of water to pass through the ditch. Figuring the 25-foot lift down to the 2-foot lift—the fall per mile in the ditch—we have 9,375,000 gallons of water raised two feet (the fall per mile in the ditch), and this each minute as against fourteen minutes for 70,000 to pass through the ditch.

I know something concerning the theory of this matter and also am aware of replies that are liable to be drawn forth; at the same time I know to a dead certainty whereof I write in this wheel matter. These wheels are here running right along unmolested week in and week out. Dozens of them are doing the same thing. I would like to have the affair straightened out some way. We are not dreaming about it, but have the demonstration here to show.

Payette, Idaho. B. W. Rice.

SHOP NOTES

THE EVOLUTION OF THE TIRE.

The greatest improvement in vehicle construction was when some bright blacksmith thought of heating the tires and shrinking them on the wheel. While many claim the honor it is not known to whom it rightly belongs. Previous to this event tires were made in short sections and held on the felloes with nails. When starting on a long haul the driver always laid in a good supply of nails to use on the trip. The West Tire Setter Co. has put into a few lines of verse this interesting historical event:

A smart smith thought of a hoop for a tire,
Welded it up when the boss was gone,
Heated it well in a circular fire,
Doused it with water and shrunk it on.
Many a smith would not believe it,
Many a head was shaken "no,"
Many a one would not receive it,
Nevertheless it was a "go."
It was a great thing, 'twas a wonderful day,
When tires were shrunk on in this new-fangled way.

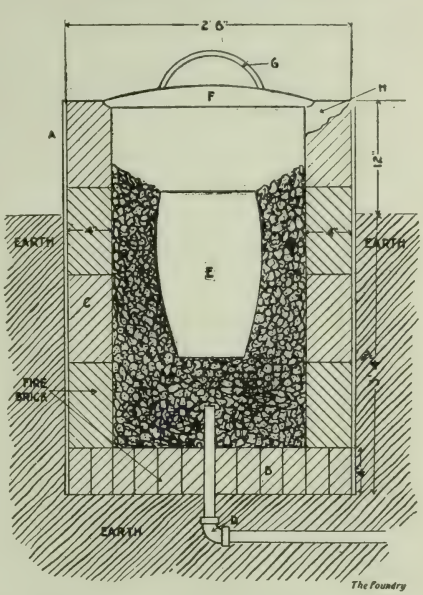
CUTTING LEFT-HAND THREAD.

To the Editor: I notice in the December number the article on cutting left-hand threads with right-hand tools. About two years ago some one advertised to tell how to do this for $5. This aroused my interest and I worked out about the same as you state except in place of the V block I placed another tap the same as on the other side. To make the nut first cut the left thread on a piece of steel, then file the gutters in it and temper it and cut the nuts.—T. N. Phillips.

HOW TO BUILD AN EMERGENCY BRASS FURNACE.

A small foundry and repair shop had occasion to use a small brass furnace for very immediate work. It is so simple in construction and has given such excellent results we illustrate it here with a condensed description from the Foundry. The cut shows a section of the furnace:

It consists of an outer shell A lined with fire brick as shown at C. The bottom of the furnace is all composed of fire brick. The cast iron cover F is provided with an iron handle G. The products of combustion escape through nicks cut on the edge of the brick work as shown at H. Dimensions are shown on illustration. The blast is taken from a small centrifugal blower which supplies the blast for the forges in the smithshop and is introduced through a one and one-quarter inch pipe shown at G.



This pipe extends about four inches above the bottom of the furnace. The fuel consists of anthracite coal of about grate-size. A bed of about 8 to 12 inches thick, depending upon the charge to be melted, is placed in the bottom of the furnace and the crucible E, set on top of it; coal is then filled in around the sides of the crucible up to the top as shown.

GIVING IRON AWAY.

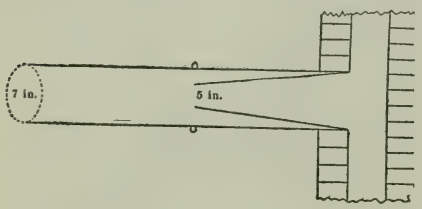
Many a manufacturing concern—and they are not all large ones—are giving away tons of iron or other metals, every year, and don't know it. The Foundry explains how this is done. It occurs in castings of considerable weight, of 250 pounds up. For instance, a large number of castings are required, to weigh, say, 250 pounds. To avoid constant repairs to a wooden pattern, an iron one is used. The pattern being heavy sinks deeper into the sand than the wooden pattern, during the rapping before its removal from the mold. This enlarges

the mold on all sides and at the bottom. When the castings are weighed it will be found that the one cast in a mold which was excessively rapped will weigh 275 pounds, or even more, instead of 250, as intended. As the manufacturer in making his price estimated on only 250 pounds, he loses the value of 25 pounds on each one.

The same result can also occur from a too rapid pouring of the metal, causing the mold to enlarge from sudden pressure, and by overfilling the riser and gates.

TO CHECK EXCESSIVE FURNACE DRAFT.

The illustration will be sufficient direction from which to construct an effective check draft for a house furnace. The furnace had an excessive draft and fairly pulled coal up the chimney, says the American Artisan.



The smoke pipe of seven inches diameter was tapered down to five where it entered the chimney. This did no good. Then a pipe section, as shown in the cut, was installed, creating an eddy, and curing the trouble.

OILING CYLINDER OF AIR COMPRESSOR.

In an address before an engineering society M. E. Stover said:

In lubricating the interior of an air compressor cylinder conditions will be found different from those existing in a steam engine cylinder. In the former the heat is dry, while in the latter moisture is always present. Moisture has a tendency to wash oil from the surfaces, whereas with a dry heat the oil adheres to the surfaces better, with the result that a given amount of oil will give better and longer service in the air cylinder than in a steam engine cylinder, both being of equal size.

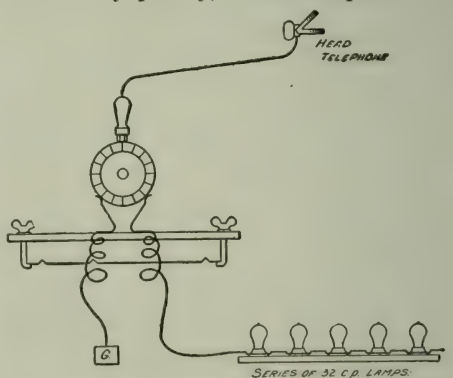
Owing to the intense heat, the oil used in an air-compressing cylinder must be of such a nature that it will not deposit a coating of carbon or burnt oil in and around the discharge valves of the compressor. If of too low flash test, the oil, on reaching the interior of compressor, will vaporize and pass off with the air without affording any lubrication to the wearing surfaces. If the oil is too dense, or is compounded with animal or vegetable oils, it will have a tendency to adhere to the discharge valves and passages, and will gradually change to a hard, brittle crust or layer of carbon, which in time will completely choke up the passages and render the valves inoperative.

RAPID METHOD OF TESTING ARMATURES.

A handy device which can be rigged in any shop, for testing armatures, is in use by the street railway at Postmouth, O., and is described in the Street Railway Review. The test is made quickly, but surely.

The armature to be tested is mounted between lathe centers and tested just after the last turning down of the commutator. A board clamped to the lathe carriage carries two brushes so placed as to make contact on the commutator 90 degrees apart; one brush is connected to the ground and the other to the trolley through a series of 32 c. p. lamps. Any telephone may be used with a head receiver to allow the operator two hands to work with. The operator should stand on an insulated platform to prevent accidental shock, in case the trolley contact should happen to be made and the ground contact broken.

The testing operation is as follows: Place the two contacts which connect with the telephone on adjacent bars; if everything is normal, and there are no open or short circuits, the operator will hear the generator current very plainly, as the telephone is in



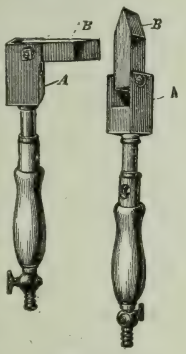
DEVICE FOR TESTING ARMATURES.

multiple with an armature coil. The armature is revolved and each pair of bars tested. Should two bars be short circuited no sound, or very little, will be heard, depending upon the resistance of the short.

If there is an open circuit no sound will be heard between any bars until the bars are found between which the open circuit occurs, when a very large sound results, as the telephone is in parallel with half the coils in series. The time required for testing by this method is only a few minutes and the cost is trifling.

NEW SOLDERING IRON.

An extremely practical gas soldering iron was recently placed upon the Berlin market. As is apparent from the illustration, the copper bit is movable and can be placed at any desired angle. By virtue of this construction the iron is of great convenience in soldering metallic edges so located as to be difficult of access. The heat generated by the gas flame (Bunsen burner) is utilized to its fullest extent in that the hollow part (A) prevents rapid radiation and concentrates the heat upon the copper bit (B). This system of heating develops a sufficiently high temperature to permit of the employment of a comparatively small piece of copper in the bit and also economizes in the amount of gas consumed. The size of the flame can be regulated at will and the apparatus attached to any gas jet by means of a hose and operated without the employment of a bellows. The short length and comparatively light weight of the iron makes it a most convenient and handy tool to manipulate.



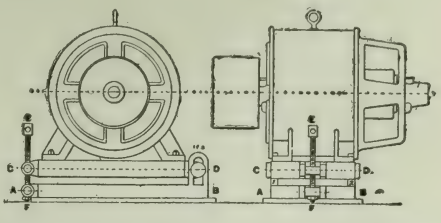
TO TIGHTEN VERTICAL MOTOR BELT.

In an English shop, where the machinery is driven by electric motors, it was necessary to use a vertical belt. The method of taking up the stretch in the belt is described in the Electrical Review, London:

A B is a fixed casting, fixed to the floor with foundation bolts, having cast on to it two slotted lugs 1 and 2.

C D is a similar casting, to which is bolted the motor. At D it is hinged to 1 and 2 by bolts which can be moved up and down the slots in 1 and 2. At C are two lugs having a nut through which the screw E F passes, being fixed at F.

When the belt is first put on C D is fixed at the top of the lugs, then the motor is levelled by screw E F, and as belt stretches C D is lowered (at one end), and when it



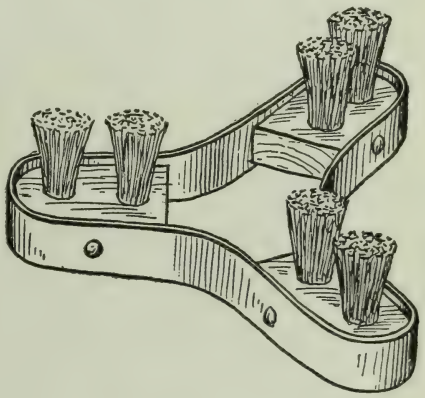
is in contact with A B and more adjustment is required, C D is lowered at the slotted lugs 1 and 2.

MILLER'S BRUSH TO CLEAN CORNERS.

A home-made device, easily prepared, for cleaning the corners of sieves in flour mills, is described in the American Miller.

This brush is made of spring steel bent into three U-shaped arms. In each arm is riveted a block of wood with bristles.

The advantage claimed is that it will never get out of shape or break. It will



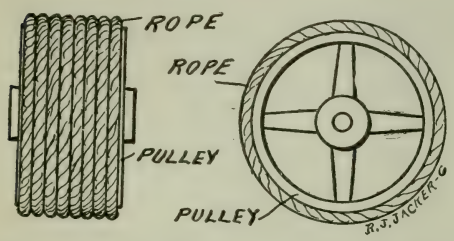
clean the corners of the sieve. It will not get clogged in the corners. It will rebound in an irregular course, thus covering all parts of the sieve. It can be made large or small, light or heavy, to suit conditions.

GASOLINE BOATS FASTER THAN STEAM.

A small boat, with say, 25-horse-power, will make better speed with a gasoline motor than a steam engine. The explanation is in the saving in weight of boiler, fuel and piping. The gasoline motor also occupies very much less space.

INCREASING PULLEY DIAMETER.

To increase the diameter of a pulley, take a four-strand manila rope and make one end fast with a hook-shaped, quarter-inch bolt. Wrap the rope tightly around the pulley, making the other end fast in the same



manner as the first one. An 8-inch pulley covered with inch rope may be used to drive a large wheat elevator. This is an inexpensive way to make a pulley larger and still leave the face true. It only takes a little time to do the work.

TREATMENT OF SOLDERING IRON.

Editor Popular Mechanics: Will you kindly give a few suggestions on the care and treatment of a soldering iron used by carriage lamp makers. What is the best method of keeping the iron bright? What is the best acid in use for soldering that class of work?

Mr. P. Rubenstein, of the Chicago Silver Plating Works, who has wide experience in this line, states: Of course it is the gas or charcoal or whatever is used in heating the iron that blackens it. To keep the iron bright first prepare a solution as follows: Put a quarter pound of sal ammoniac into a pint of water and permit it to thoroughly dissolve. Dip the iron into the solution and it will brighten immediately.

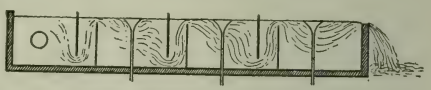
The iron needs filing every three or four hours to keep it in good condition. If it is not filed frequently it will acquire such a heavy coating of tin that it will not melt the solder.

The best acid to use for soldering this class of work is muriatic acid, cut down with zinc until it will not eat (dissolve) any more zinc. Then take three parts of the acid, cut down with the zinc, to one part of water. Be sure and clean well the parts that need soldering. Be sure and do not mix the acid and zinc in the house, for the gas that escapes when it boils up is somewhat suffocating and poisonous.

TO RECOVER CYLINDER OIL FROM CONDENSING ENGINES.

In the power house of the Camden & Suburban railway is a unique device for recovering cylinder oil. Part of the time the exhaust is discharged into the condensers. The Street Railway Journal describes a very novel and economical feature of the oiling system in an arrangement both for recovering the cylinder oil and utilizing the latent heat in the water in the hot well. The overflow from the condensers discharges into a large concrete and masonry tank, 60 ft. long by 14 ft. wide by 6 ft. deep, set the level of the boiler room floor.

This receptacle, a rough section of which is here shown, is divided by barriers into four compartments, the barriers being so arranged that the water has to flow over the first, then under the second, over the



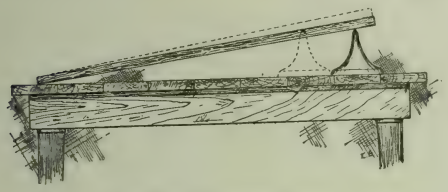
SECTION OF HOT-WELL TANK, SHOWING SKIMMERS FOR RECOVERING CYLINDER OIL

third, and so on. The overflow from condensers is led into the first of these compartments, and as it flows under and over the barriers of the tank the cylinder oil collects on the surface of the water in each compartment. In this position it is automatically skimmed off by funnel-shaped drain pipes, about 6 ins. in diameter at the top, as illustrated. It has been found possible in this way to recover about one-fifth of the oil used in cylinder lubrication. It has also been found not only practicable but desirable to use the overflow of this tank for boiler feed purposes. The temperature of the water averages about 115 degrees F., and the little oil that is mixed with the water seems to act as a boiler compound and be just enough to precipitate the mineral matter in the water; in fact, since the introduction of this water the boilers have been entirely free from scale or corrosion.

John J. Camp, of Seattle, Wash., will start in a gasoline launch 18 feet long, and attempt to follow the western coast down to Cape Horn, and then up the Atlantic shore to the St. Lawrence river. Thence through the Great Lakes to the Mississippi, up the Missouri and Snake rivers, where a short portage will bring him to the Columbia river, and thence home.

CASTING TO ELEVATE DRAFTING BOARD.

Where it is desired to use a drafting board on a flat table, the castings shown in the cut will be found of service. The Draftsman says the base of the casting should be 4½ inches in diameter, the height



Elevating Drafting Board

4 inches, terminating in a sharp point which holds the board and prevents slipping. By moving the casting various elevations of the board are secured.

BURNISHING NICKEL PLATE ON HAND LATHE.

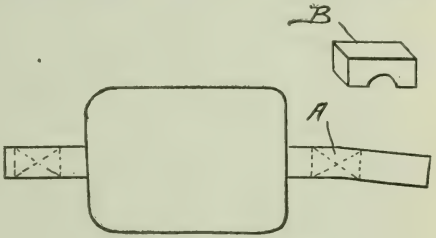
Nickel plated articles capable of being handled rapidly can be profitably burnished on a hand lathe. Some manufacturers prefer this method to buffing and the finish is more durable. In buffing a certain amount of plate is worn off, while in burnishing the surface is hardened under the burnishing tool. J. W. Force, in Metal Industry, says: I have been using the burnishing process for buttons, and some 1200 gross are treated every day. To accomplish the result, however, the solution must be properly made and maintained. The coating also must be very light; only just enough to cover the article should be put on. I use a solution which does not stand over 5 degrees hydrometer test, and even a little less is better than over.

The method which I use is as follows—viz.; The articles to be plated are first sent to the dipping department and dipped in the usual brass dip until a good, bright, clean finish is produced. They are then rinsed in cold water, then in hot water and afterward dried in sawdust. They are now sent to the plating department. The articles are now placed in baskets, rinsed in potash solution and then in cyanide solution. The next operation is to rinse thoroughly in three waters and place in plating baskets in the plating bath. The plating is allowed to continue until a light coating is produced. They are then thoroughly rinsed in cold water, then in hot water and dried in sawdust and afterward sent to the burnishing department.. The burnishing is accomplished with the ordinary suds and burnisher.

HOW TO STAIGHTEN A SHAFT.

The following description of a quick repair of a bent shaft of an electric motor in a mill may prove useful some day. The American Miller says the shaft was bent at A, being on a bearing. The bearing could not be turned down, nor could it be mutilated from pounding. The shaft was straightened without doing either.

Mr. London had an iron, B, forged to fit about one-third of the way around the shaft. This was heated in a furnace and while hot was placed on the concave side of the bent shaft. When the shaft was slightly beyond straight the iron, B, was removed



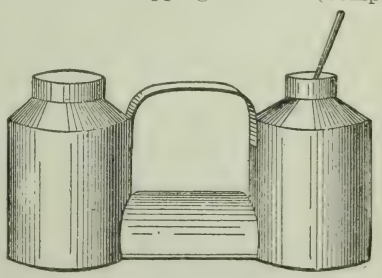
Straightening a Bent Shaft

and the shaft became straight. The heat had expanded the one side of the shaft enough to leave it perfectly straight.

DIP AND ACID CUP.

A handy device for tinners, which can easily be made is described in the American Artisan. It is especially convenient for work outside the shop.

Make two bottle-shaped cups of copper and join together with a boss and handle. In one of the cups put your flux and in the other the dipping solution (composed

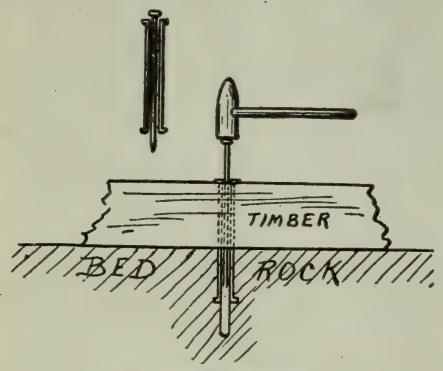


Dip and Acid Cup

of weakened flux or acid). Let the opening of the dip cup be larger than the acid cup, so you can always tell in which to put your coppers. Tin and horse hair make the swab.

TO FASTEN DAM TIMBERS TO ROCK BOTTOM.

The difficult task of securely anchoring timbers to a rock bottom for dam or other similar construction is made easy by a

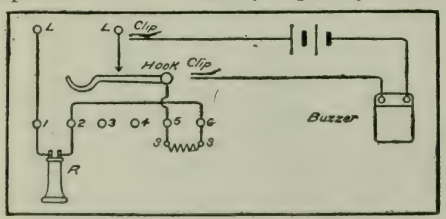


Method of Anchoring

writer in the American Miller. The illustration tells the whole story. Any blacksmith can make the fastenings, to be used as shown in the cut.

HOW TO MAKE A TELEPHONE TESTING INSTRUMENT.

It is often quite handy to a telephone inspector to have a simple testing apparatus with him while he is making his rounds, says the American Telephone Journal. The one here described is easily made, and will be found practical. It requires but a couple of small dry batteries, vest-pocket size, and a small buzzer. The dry batteries and buzzer can be carried in the pocket or a better arrangement is to mount them in a small box with a pair of flexible cords, to the ends of which snaps are soldered. Old suspender snaps will be found to answer the purpose admirably. When a station is in trouble the inspector can usually quickly decide



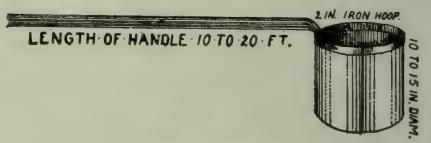
Telephone Testing Dovice

whether it is the primary or secondary circuit that is at fault. The figure represents the secondary circuit of a telephone substation instrument. Supposing an open is suspected that cannot be easily located, the inspector attaches one snap from his buzzer to the line post L' and the other he touches to the hook switch. If the buzzer sounds here, he is sure that that part of the circuit is closed, and then touches bind post number 5, still leaving the first snap at L'. If the buzzer fails to sound at 5 it is evident that the trouble is in the wire between the switch hook and the bind post 5. If, however, the buzzer sounds at 5, and does not at 6 it is evident that the open is in the secondary of the induction coil. The buzzer is better than a telephone receiver for this sort of work, as enough current to make a distinctly audible click in the receiver might flow across a partial open, while the buzzer, under the same circumstances, would not sound.

TO MAKE A CISTERN CLEANER.

Here is a description of a really good cistern cleaner, condensed from the American Artisan, with which a cistern can be cleaned without pumping out the water.

It is made of 2-in. hoop iron bent into a 10 or 15 inch circle with 6-inch straps for



Cistern Cleaner

fastening to handle. One side of the circular rim is sharp and the other is punched full of holes, say about one inch apart. Sew to this rim a sack about 15 inches deep, made preferably of gunny cloth (coffee sack) wide enough to fit the rim neatly. Sew sack to rim with malleable wire.

This is the best known cleaner, as it has a good edge for scraping up the dirt while the sack allows escape of surplus water. The sack must be sewn inside, or in such a manner so as to protect from wear near the hoop circle.

The new cruiser Maryland, which was successfully launched at Newport News recently, is 502 feet on load water line; extreme breadth 69 feet 6½ inches; trial displacement, 13,860 tons; mean draft at trial displacement, 24 feet 1 inch.

When the piano manufacturers hold their convention at Atlantic City, N. J., next summer, one of the attractions will be a great piano bonfire. A huge pile of old square pianos will be stacked on the beach, sprayed with petroleum and burned.

WHAT TO DO WITH OLD RANGE BOILERS.

A kitchen range boiler when put out of service seems to be one of the most useless things in the world. Patching and mending are a waste of money. The junk man refuses to buy them, and the plumber feels imposed upon when requested to take them away. And yet, but for some apparently insignificant weakness, the boiler which cost from $25 to $50 seems good for many years to come. A writer in the Metal Worker has discovered uses for these discarded boilers; some of them are shown in the illustration. In Pennsylvania many house holders burn their refuse and garbage; the old boiler makes an excellent incinerator by cutting off the top and inserting a grate 15 inches from the bottom. Fig. 2 is a water trough. Fig. 3 a device used by Ohio river fishermen to tar their nets, the nets being dipped in the hot tar. Figs. 4 and 5 speak for themselves. Fig. 6 shows a section of old boiler used as an expansion tank for a greenhouse heated with hot water. The height of the water in the tank is a reliable indication of its heat. The pipe holes in old boilers can be stopped with wood or iron screw plugs.

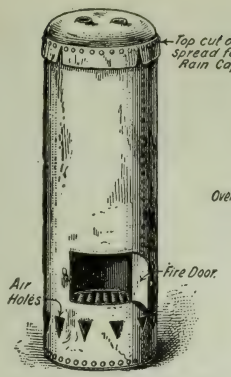


FIG. 1 GARBAGE INCINERATOR.

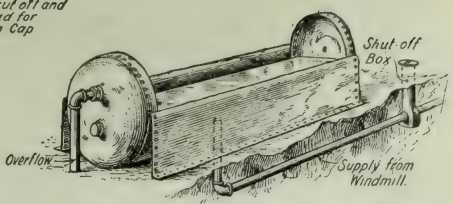


FIG. 2. A KENTUCKY TAVERN DRINKING TROUGH.

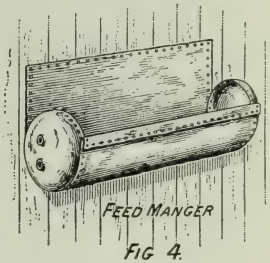


FIG. 4.

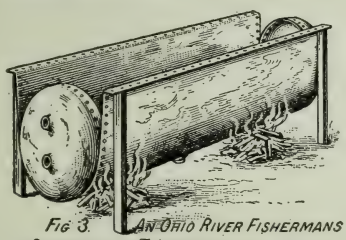


FIG. 3. AN OHIO RIVER FISHERMANS SCHEME FOR TARRING NETS.

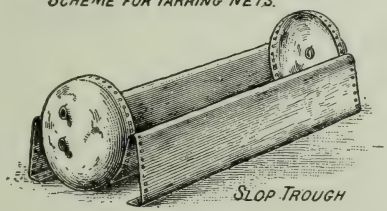
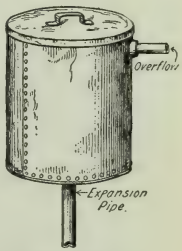


FIG. 5



EXPANSION TANK. FIG. 6.

With both ends cut off they make good culverts. A rod through the center with a handle transforms an old boiler into a good lawn roller. With one end cut off and buried in the ground it makes a fairly good refrigerator as a temperature of 52 degrees can be thus secured. Other uses will suggest themselves to our readers.

The Prince of Wales has a most extraordinary design tattooed on his arm. It takes the form of a fearful looking dragon, with open jaws bristling with rows of gigantic teeth, and a row of spiked horns down the middle of its back.

FREIGHT CARS ORDERED IN 1903.

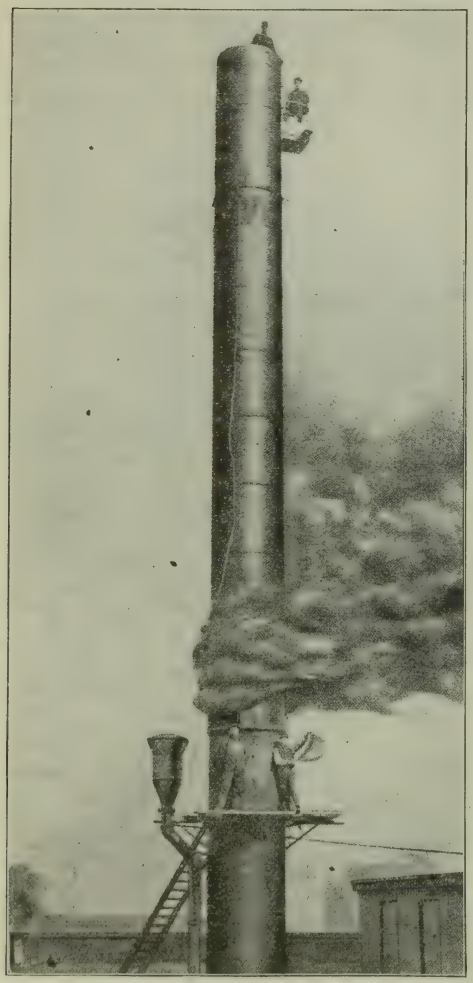
There is always great interest in railroad circles to know the number of freight cars ordered during the year, as affording an indication of traffic present and prospective. The Railway Age has compiled the figures, which are: Freight cars, 108,936; passenger equipment, 2,310; locomotives, 3,283.

In 1902 the orders were: Freight cars, 195,248; passenger equipment, 3,459; and locomotives, 4,665.

A Toledo, O., man has invented a self-starting gasoline engine for automobiles. The engine is a vertical two-cylinder, and after being once started in the morning will start any time during the day by pushing a button. One cylinder always is charged with compressed gas, which of course would lose its efficiency in about 20 hours.

LENGTHENING A SMOKESTACK WHILE IN USE.

The 110-foot round iron smokestack of the Century Building in Indianapolis was recently lengthened 60 feet while the boilers and plant were in full operation. The



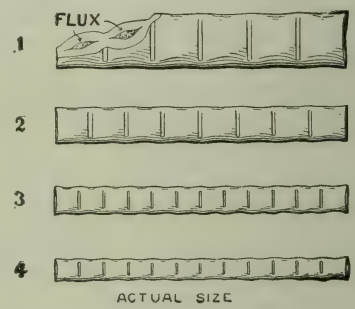
Lengthing a Stack While in Use

stack had long been a source of annoyance to occupants of nearby tall buildings, and to extend it without banking the fires and shutting off the power of the manufacturing companies occupying the Century Building was considered impossible by local engineers. W. H. Schott, consulting engineer of Chicago, was called upon and in an ingenious and effective way accomplished the job. A damper was placed in the old stack a few feet below the top and two holes were cut into the sides a short distance below the damper. This permitted the escape of the smoke and gases, and the workmen were able to rivet the previously prepared sheets into place with but little difficulty. The stack is five feet in diameter and was extended to a height of 170 feet in eight days. The accompanying illustration is reproduced from the Iron Age.

SOLDERING.

The best solder for ordinary purposes is called "half and half," i. e. 50 per cent tin and 50 per cent lead. More lead and less tin makes softer and poorer solder and raises the melting point. An addition of proper proportion of bismuth reduces the melting point but greatly increases the cost.

To join surfaces by solder, they must be thoroughly clean and heated sufficiently to melt the solder. Heating causes both the solder and the surfaces to rapidly oxidize and oxides are fatal to good joints. To pre-



vent oxidization as much as possible and to carry the oxides away, acid or fluxes are used. An excellent flux is one that has both an active reagent to cut away any foreign matter from surfaces and a protective ingredient which will shield the hot surfaces from the air until the solder can run in and take its place, which it does by capillary attraction.

Different metals require different fluxes.

Muriatic (HCl) acid and zinc, decanted, makes a fairly good (but corrosive) fluid for tin plate, brass, copper or steel. Tallow or stearine for lead. Rosin for lead or tin plate. These are the most common.

To "tin" a copper, do not have it too hot. File bright, quickly rub with sal ammoniac or dip in paste or salts solution and apply solder before the copper has time to oxidize.

Few manufacturers realize how much can be saved by having things convenient. At least, there are few methods employed that can not be improved upon. Most operatives have but two hands. In any case where

operations must be repeated rapidly and many times, it is important to have only two things to manipulate, one for each hand. In many, possibly most cases where the work is light, all the time spent in moving the soldering copper is lost.

However, there still remain three motions, viz., bringing the work, the flux and the solder up to the copper. These three motions can be reduced to two, when a self-fluxing solder is used.

Where the surfaces to be united are very extensive a method called "sweating" is employed. This is done in several ways. The writer has employed two methods in his experience covering many thousands of square feet of work. The first method was to coat both surfaces with solder (over a hot stove) by means of wire brush and crystal of sal ammoniac and, as soon as solder was set, to coat with rosin to prevent oxidization. The two plates thus covered were clamped face to face and "baked" in an oven.

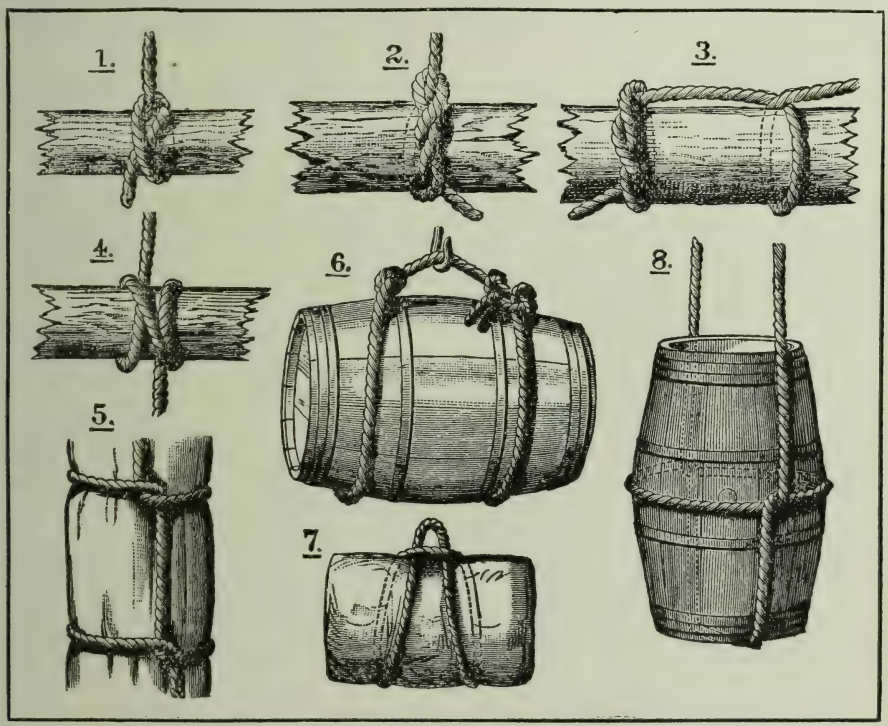
A more economical method was to lay a sheet of solder foil, 5-1000 inch thick, coated with flux, between the plates. These were clamped together and baked as above. The latter method proved more economical and reliable. The plates above mentioned were of brass or bronze twelve by forty-two inches; one plate being ⅜ inch thick and the other but 1-16 inch. Every square centimeter of the entire surface had to be soldered. By the use of self-fluxing solder it is possible to do much soldering without a copper. Merely heat the article and apply the solder.

F. G. Dickerson.

HOW TO TIE A HITCHING KNOT.

A knowledge of how to tie the hitching knots, which are a part of the education of every sailor, will be valuable to all our readers. The illustration is from the Scientific American. A piece of white cotton clothes line is most suitable for practice.

No. 1 is the so-called half hitch, which is so common as to be familiar to nearly everyone. No. 2 is known as the timber hitch, and is particularly useful when medium-sized sticks of timber are to be hauled about. No. 3 is a combination of the timber hitch and half hitch, that is particularly advantageous when longer sticks are to be handled. No. 4 is the famous clove hitch that is more frequently used than any other form of rope fastening.



Commonly Used Hoisting Hitches.

Nos. 5, 6, 7 and 8 are self-explanatory methods of making slings whereby articles of almost any shape or description may be readily attached to a fall for hoisting.

Teach Soldiers to Shoot Straight

This, the Problem of Most Vital Importance, Says Col. W. P. Hall

American Army's Fighting Strength Today and 100 Years Ago

Size of regular army	60,000
Could be mobilized at any point in the United States in five days	45,000
Could be increased in ten days to	100,000
Military reserve strength in United States	118,000
Could be recruited, equipped and mobilized in ninety days	500,000
Total available men capable of bearing arms	10,853,396

Size of the army 100 years ago: Two regiments of artillery and engineers, two companies of light dragoons, four regiments of infantry—318 officers, 4,118 men,

By Col. W. P. Hall. Acting Adjutant General, U. S. A.

The future of the military establishment of our country seems to be very bright. The harbors which it is considered best to fortify against naval forces are rapidly being put in condition to make easy their successful defense. Our land forces, our regular army and militia are being trained on lines to make them quickly available for any emergency and to give them efficiency on the field of battle. The problem of the concentration of troops at certain points is, on account of the many railroad lines and other wonderful carrying capacity, quite a simple one, while the field maneuvers, practice marches and camps of instruction give the valuable lessons required for their disposition and handling in action and teaching the soldier how to shoot his arms and hit what he shoots at.

With the long range, high power miltary weapon now in use it becomes of more vital importance than ever before that the shooter should be a good marksman. If the all-round military efficiency be designated by ten points, at least eight of them are excellence in marksmanship.

In shooting a rifle at long range, if the shooter misses the object he intends to hit, the shot is generally lost and he is something like the quail shooter who fires at the flock when the covey gets up.

The value and importance of high efficiency in military rifle shooting on the field of battle was never so forcibly illustrated as during the Santiago campaign. For eighteen years previous to this our little army had received an excellent and thorough training in target practice and was as a class fine miltary rifle shots. They had been trained, with other things, to shoot at an object the size of a man's head and shoulders between five and six hundred yards, and many of them would hit, firing rapidly nine times out of ten.

At Santiago our troops marched over an open space from four to six hundred yards to attack an enemy in well constructed rifle pits upon the other side; our loss was comparatively small, and it is acknowledged that our opponents were very poor shots, and it is said they had received little or no training in rifle shooting.

In conversaton wih a number of our fine rifle shots who were in this campaign, I have gathered these facts, and one very sensible man remarked that if our men had been in the trenches they could easily have destroyed ten times their number of an attacking force. These remarks are not intended to and cannot cast a reflection upon any soldier opposed to us.

It is like a fine tennis or golf player engaging in a game with one who cannot play a little bit; the result is inevitable.

In concluson, I will add that rifle shooting can be easily taught by proper training in the gallery and does not require a large expenditure of ammunition or much practice upon the range.

The responsibility of teaching soldiers how to shoot rests with the captains and lieutenants, and in order to teach it correctly they must know how to do it themselves.

I am glad to say that Congress is disposed to be liberal in appropriating for shooting galleries and ranges, and it is hoped our regular troops and militia and the various rifle and revolver clubs will soon be engaged in friendly shooting competitions all over the country.

In this way we will soon have an army ready to take the field on short notice, and their efficiency for effective work on the line of battle will be second to none.

A publisher has discovered that a bushel of wheat contains 869,720 grains.

The DAVIS

ARCTIC "OVER-PANTS"

Water-tight, enable you to walk into snow or mud. Always clean, adjustable, worn over or under overcoat; stay in place and look well.

The Davis "AIR-TIGHT BAG" LAP ROBE

For men or women; an ideal Automobile, Carriage ar Steamship Robe. Both are make of **Heavy Rubber Drill,** lined with **finest Plush,** leather shod, held with glove fasteners. **Put on or off instantly, "Air-tight,"** will keep **you warm and dry in any weather.**

Overcoats. price $10, - without Lining, $6.
Robe, standard, $7.50 " " $5.
"Baby Bear" Fur, (elaborate) - - $15.

THE DAVIS ROBE CO. Inc., 1302-4 Champlain Bldg., Chicago.

Money bank if they fail to please.

FOXY GRANDPA'S LATEST

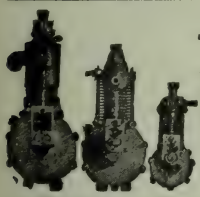
Here you are boys. A medallion pin of Foxy Grandpa, beautifully enamelled in colors. Everyone will notice it on your lapel and try to get a closer look at it. All you have to do is to press the bulb—Foxy Grandpa will finish the job by squirting a fine stream of water all over the inquisitive one. Will squirt 20 feet. Greatest joke out. Order one to day and fool all your friends. ☞ Sent postpaid on receipt of 20 cents. Address

WESTERN SPECIALTY CO.

653 Burr Street - . - St. Paul, Minn

MAGIC

I will teach you one new coin trick and one new card trick for 20 cents, or either for 10 cents. I will send *"Book of Card or Coin Tricks,"* 180 p., 25c. each, and include illus. catalog of 240 tricks free with order. Learn at home, amaze your friends, mystify, startle and entertain. ROBERT WASSMANN, Instructor in Magic, 227-z Webster Ave,, CHICAGO, ILLINOIS.



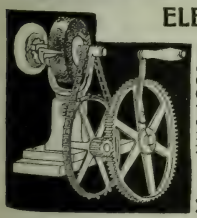
1 3-4 H. P. Bike Motor $7.50

Castings with Drawings 1904 Model

Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. Send for circular to

EUREKA MFG. & SUPPLY CO.

ST. PAUL, MINN.



ELECTRIC DIAMOND GRINDER

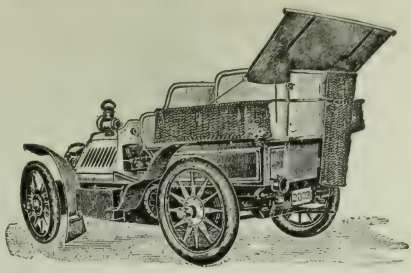
Shipped on 10 days FREE TRIAL, 3,000 revolutions per minute. Only Hand Power Grinder with CARBORUNDUM wheels. Cuts eight times faster than emery, twenty times faster than sandstone. Will not draw temper. Try it FREE. If not satisfactory return at our expense. If satisfactory remit us $4.50.

LUTHER BROS.

Dept. P. M. North Milwaukee, Wis.

DUST DEFLECTORS FOR AUTOS.

A deflector which can be attached to any automobile, and which prevents the dust thrown up by the



wheels from pouring over the occupants, is a recent invention. The cut shows the manner in which it is used.

DELAYS ARE COSTLY.

In no other line of work is the danger of delay greater than in that of securing a patent on a new idea, that is, if the inventor has any intention of protecting his rights. Procrastination in applying for a patent promptly has robbed many a man of a fortune which was almost within his grasp.

It is said of one of the greatest electrical patents ever issued, that the real inventor thinking the danger remote of anyone else conceiving the same idea, instead of applying for his patent made application instead for a caveat, intending to make further improvements and have the paper issued on the final perfected device.

While he was still engaged in leisurely working out an improvement, another with more push, submitted a complete model and was granted the patent, which subsequent litigation involving hundreds of thousands of dollars did not invalidate. The result was that the originator of one of the most valuable patents ever granted in any country, never realized on his ideas, and spent his money and that of his friends in trying to recover the lost ground. One man made millions; the other remains comparatively poor.

The commissioner of patents, and the courts give preference to the diligent inventor; the one who asks for his patent while the other is thinking about doing so. The latter may really be, and frequently is, the original inventor, but the patent office can recognize only the one who comes to it first; it cannot go about the country advertising for the original inventor; it can only take notice of the one who first presents his claims, and such an one is considered legally the worthy party.

If you have an invention which you think is worth patenting at all, better "do it now."

SPECIFY

CRANE VALVES

WRITE FOR POCKET CATALOGUE

NEW YORK
PHILADELPHIA
CINCINNATI
KANSAS CITY
SIOUX CITY
OMAHA

CRANE CO.

CHICAGO

ESTABLISHED 1855

ST. PAUL
ST. LOUIS
LOS ANGELES
SAN FRANCISCO
PORTLAND, ORE.

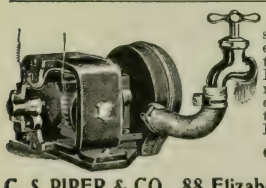
PATENTS promptly secured
Trade Marks, Copyrights and Labels registered. Send photo sketch or model for FREE examinations as to patent ability. No fee till case allowed. Write
J. ALBERT WILLSON, Opp. Patent Office, WASHINGTON, D. C.

PATENT YOUR IDEAS
$100,000 offered for one invention; $8,500 for another. Book "How to Obtain a Patent" and "What to Invent" sent free. Send rough sketch for free report as to patentability. We advertise your patent for sale at our expense.
CHANDLEE & CHANDLEE, Patent Attorneys
918 F Street, Washington, D. C.

DIES, TOOLS, MODELS AND SPECIAL MACHINERY
Metal Specialties and Stampings Manufactured
HOEFT & MOORE, Chicago, U. S. A.
OFFICE: 85-87 Fifth Ave. WORKS: Indiana and Franklin Sts.

BRIDGES, ELECTRIC AND STEAM RAILWAY FACTORIES AND POWER PLANTS
W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

MODELS & GEARS
CATALOGUES FREE
UNION MODEL WORKS
193 CLARK CHICAGO.



We manufacture the best designed, finest constructed, most efficient type and cheapest, miniature water power plant for the Electrical Student and Experimenter. Capacity 25 watts. Price complete $9.00. Postal brings interesting circulars. Write now. Don't delay.
GOOD LIVE AGENTS WANTED
C. S. PIPER & CO., 88 Elizabeth St., East, Detroit, Mich.

MODELS
CHICAGO MODEL WORKS
179 E MADISON ST., CHICAGO, ILL.
ESTABLISHED 1867 WRITE FOR CATALOGUE OF MODEL SUPPLIES

Automobile Sprockets

Carried in stock and made to your order
Write for our new catalogue
CULLMAN WHEEL COMPANY
521-525 Larrabee Street, Chicago

DREW THE WRONG LEVER.

This is what the switchman said,
With both hands at his throbbing head:
"I pulled the wrong lever standing here,
And the safety signal stood out clear;
But before I could draw it back again,
In came the fast express and then—
Then came a roar and a crash that shook
This cabin floor, but I would not look
At the wreck, for I knew the dead would peer
With strange dull eyes at their murderer here."
"Drew the wrong lever!" "Yes, I say!
Go, tell my wife, and—take me away!"

That was what the switchman said,
With both hands at his throbbing head.
O' ye of the twentieth century time,
Who hold low dividends as a crime,
Listen! So long as twelve hours' strain
Rests like a load of lead on the brain,
With its ringing of bells and its rolling of wheels,
Drawing of levers until one feels
The hands grow numb with a nerveless touch,
And the handles shake and slip in the clutch,
So long will you have the switchman say,
"Drew the wrong lever; take me away!

GERMANY GETS PEKING LIGHTING CONTRACT.

The Chinese government has placed an order with a Hamburg firm for a new electric lighting plant in Peking for lighting the Chinese imperial palaces in and near the capitol. The new plant is to take the place of one destroyed during the Boxer disturbances. The installation is to be worked on the alternating curret system and comprises four steam engines and boilers and 16 transformers. The plant will supply light to the winter palace with its extensive grounds in the center of the city and to the summer residence outside the city.

QUICK STOPPING OF ELECTRIC CARS.

In recent European experiments it was found that an electric car could make an emergency stop from a speed of 20 miles an hour in 88 feet, which was just 2½ times the length of the car. The stop was effected by reversing the motors, an appliance being used which prevented the controller from being moved over too rapidly and thus skidding the wheels. With the same device used in starting, the car attained a speed of 20 miles an hour in 16 seconds and of 18¼ miles an hour in 12 seconds.

CUNARD INVESTIGATES THE TURBINE.

To determine upon the advisability of equipping all their new steamers with turbines, the Cunard Steamship Company has appointed a commission to make a thorough investigation of turbine propulsion. Economy in space, fuel consumption and speed are the main questions to be inquired into. A favorable report by the commission will doubtless mean the universal adoption of the turbine for ocean traffic.

HINTS TO INVENTORS.

A movable cellar step which, when trod upon, will turn off a switch and thus extinguish all electric lights, is suggested as a needed invention. It is claimed that the device would meet a ready market because of the general carelessness of warehousemen.

PATENTS

Caveats,
Trade-Marks
Copyrights
and Designs

SEND YOUR BUSINESS DIRECT TO WASHINGTON
SAVES TIME AND INSURES BETTER SERVICE

Personal Attention Guaranteed; Twenty-Three Years' Active Practice

Address **SPECIALTY: Patents that Protect**

SIGGERS & SIGGERS, Patent Lawyers, Box 27, N. U. Building, WASHINGTON, D. C.

PATENTS

Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to any one having need of the services of a patent attorney."
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. patent office to enter this firm. Address
210 Revenue Building - - WASHINGTON, D. C.

MODELS AND SUPPLIES

WE MAKE

Working Models of Your Invention

After drawing or description, and charge moderate and fixed price for them. Experience, skill and modern equipped shop enables us to satisfy and assist you.

Send for Illustrated Catalog of Appliance for Models

J. WEINERT & CO., 134 Pierce Ave., Chicago

PATENTS

Skillful prosecution positively guaranteed. Rejected cases a specialty. Installments taken. Write for particulars. No charge for opinion as to patentability, etc. **$20.00**

THOS. A. HILL, Patent Attorney & Consulting Engineer
Main office: 261 Broadway, New York City
Skilled associates in Washington and abroad

PATENTS

Protect Your Ideas

Consultation Free
Fee Dependent on Succes
Established 1864
MILO B. STEVENS & CO
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

SPECIAL MANUFACTURING

Special MACHINERY-MODELS-EXPERIMENTAL WORK. DIES and STAMPING. Prompt. "Write for our booklet." The GLOBE MACH. & STAMPING CO.
970 Hamilton Street . . . Cleveland, Ohio

IF YOU WISH TO BUY

PATENTED INVENTIONS
OF ANY DESCRIPTION

Mail Order Articles, or complicated Machinery, I can put you in touch with owners who wish to sell.

CHARLES A. SCOTT
Granite Building, - - - Rochester, N. Y.

F. D. CROFOOT N. NIELSON

BLUE PRINTING BY ELECTRIC LIGHT

BLUE PRINTERS BLUE PRINTING, BLACK PRINTING, BLUE LINE & COLOR PRINTING
WRITE FOR PRICES.

CROFOOT, NEILSEN & CO.
167-169 E. Washington St. - - CHICAGO

Inventors

You have an invention. You don't know what to do with it—don't know how to proceed. An expert inventor and successful promoter will tell you what to do. Will tell you if it's practical, how to interest capital, etc. **Builds models (Metal, Wood, Rubber, Glass, etc.)** Write (in confidence) for plan, testimonials, etc.

LOUIS CASPER
701 Western Union Bldg., Chicago

WANTED

10 men in each state to travel, tack signs and distribute circulars and samples of our goods. Salary $60.00 per month, $3.00 per day for expenses.
KUHLMAN CO., Dept. F, Atlas Block, CHICAGO

A FREE BOOKLET FOR INVENTORS

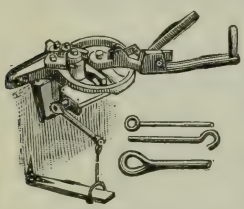
Gives valuable information to those contemplating taking out American or Foreign Patents. It will save you money and time. Mailed free if you mention Popular Mechanics. Address
Robert Klotz & Co., Schiller Building., Chicago, Ill

J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing
165-167 Dearborn St. Chicago

TOWER ORNAMENTS

WEATHER VANES
COPPER LIGHTNING RODS
CHURCH CROSSES
COPPER FINIALS, etc.

80 page illustrated Catalogue mailed free
T. W. JONES, Mfr., 18 Fletcher St., N. Y. Est, 1862



EYE BENDERS.

We make HAND power benders for forming eyes from stock 1 3-8 inch thick and under. Any size eye 7 inches outside diameter and under.

WALLACE SUPPLY CO.
900 Royal Ins. Bldg., Chicago

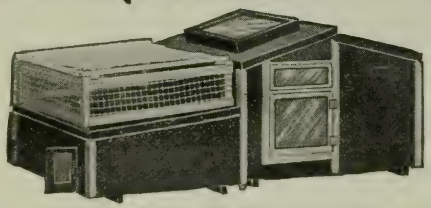
FARMERS, BUTCHERS, MECHANICS

AND ALL WHO USE SAWS
FILE THEM WITH

Roth's Saw Filer

This filer is giving universal satisfaction, and with it any person can file a saw. Outfit free. For circulars, terms to agents, etc., address G. H. ROTH, New Oxford, Pa.

TWO BROODERS IN ONE



THE TWO-STORY BROODER

Both floors heated by one lamp—contains 25 square feet of floor space, simple to operate, well constructed. Investigate. Illustrated Catalogue Free.

The Two-Story Brooder Co.
161 LA SALLE ST., CHICAGO, ILL.

THIS ONE SAVES YOU 1/3

Write today for Free Catalog and Poultry Book describing NEW IDEA INCUBATOR. Most durably built, best regulator, heater, lamp tanks, etc. Complete at only two-thirds cost of other high-grade machines. Write today. Address CHANNON, SNOW & CO. Box 162 Quincy, Ill

I J. F. Siems, want every one to know all about the

Natural Hen Incubator

and will be greatly pleased to send our catalogue, telling all about it, together with a 25c Lice Formula Free of charge If you send us your address. Only plan totally different from all others. 200 egg hatcher only $3. Agents wanted everywhere, either sex. No experience necessary. Secure your territory at once. Address

NATURAL HEN INCUBATOR CO., Box B- 27, Columbus, Neb.

ENORMOUS STRENGTH OF NICKEL STEEL.

The standard specifications for medium structural steel call for a tensile strength of from 60,000 to 70,000 pounds per square inch, an elastic limit of not less than one-half the ultimate strength and an elongation in 8 inches of 22 per cent. The average elastic limit of nickel steel is approximately the tensile strength and double the elastic limit of medium structural steel, while the tensile strength has been increased about 50 per cent and the elongation in a rolled carbon steel of approximately 100,000 pounds tensile strength has been found to be not more than 12 per cent.

SELIUM LIGHTER AND HARDER THAN ALUMINUM.

Selium is the name of a new metal that has been discovered in France by M. Edward Mollard. He asserts that it costs only one-twelfth as much as aluminum and is lighter and stronger. It does not rust and is therefore suitable for shipbuilding, pipe manufacturing, etc. It is capable of taking a fine polish resembling nickel, the discoverer says, and its strength is greater than that of iron.

OIL-PROPELLED MOTOR COACH IN ENGLAND.

An oil-propelled motor railroad coach is being built for the Great Northern Railroad of Great Britain. The car is to be of standard gage, with a capacity for 30 passengers. The motor will develop 40 horsepower. A cab will be fitter at either end of the vehicle for the accommodation of the engineer so that the coach may be propelled either backward or forward and the engineer will always be at the front of the vehicle.

WINTER HOME OF THE COD FOUND.

The home of the cod in winter, which has long been an object of search by scientists, has just been discovered. It is away out in the open sea, where it is many thousands of feet deep. There Dr. Hart, who made the discovery, found cod and other fish in layers like ocean strata. Some required a line as long as a monument to reach them; others were in still lower depths which would submerge the Masonic Temple and with many thousand feet of water below them.

There, in these still and dark, and hitherto supposed barren regions, says the Marine Journal, Dr. Hart caught great cod and haddock, sometimes in quantities. The importance of this discovery is that it proves that fish not only fish brood, but mature fish also, exist out in the open and that what have been looked upon as typically "ground fish" and "local" sorts are to be found in other places as well as near the coasts.

VOLCANO UNDER PARIS.

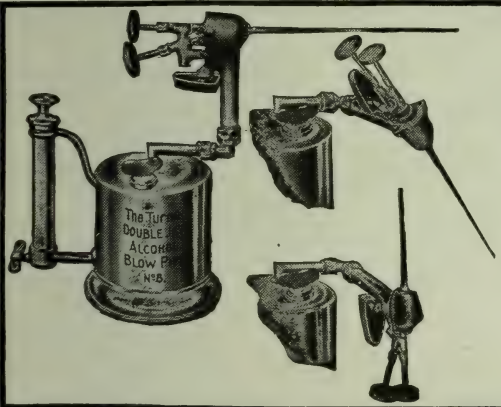
From sulphur mines to volcanoes is a natural graduation. M. Stanislas Meunier has analyzed the soil beneath the Place de la Republique, Paris, and found considerable deposits of sulphur. The scientist has told the Academie des Sciences that it is really and truly a budding volcano that runs underneath not only the Place de Republique but also the Boulevard St. Martin. The volcano is described as inoffensive.

ECONOMICAL
Because of the small Quantity necessary
QUICK ACTING
Because less Heat and Time is required
RELIABLE
Because it never fails to make a perfect Joint
THE CRESCENT CO.—CHICAGO.
THE CRESCENT CO. CHICAGO.
The Crescent Soldering Stick
FOR SALE BY SUPPLY HOUSES EVERYWHERE
Sample Stick mailed to any Address in United States on Receipt of 25 Cents.

CRESCENT SOLDERING STICKS
and
CRESCENT SOLDERING PASTE

are not an "accident."—They are the results of a deliberate attempt, along scientific lines, to produce a soldering flux that would prove satisfactory to the practical electrician. They do the work always; never fail.
To introduce these we will send postpaid, 1 doz. of either stick or paste for $1.40.

CRESCENT CO., Room 401 Omaha Bldg. Chicago



Needle Flame
WITHOUT BELLOWS

The Turner Double Jet Alcohol Blow Pipe burns wood alcohol and produces a temperature of over 3000 degrees. Flame is non-oxidizing and adjustable up to 4 inches. Unexcelled for Jewelers' and Opticians' work, Soldering Fine Wires, Lead Burning, Etc.

Send for descriptive circular

The Turner Brass Works

55 N. FRANKLIN ST. . . CHICAGO

MACHINERY BARGAINS

SEND FOR MY PRINTED PRICE LIST OF

Automatic and Slide Valve Engines, Hoisting Engines, Boilers, Heaters, Air Compressors, Rock Drills, Crushers, Locomotives, Steam Shovels, Pile Drivers, Dump Cars, Dredge Machines, Traveling Derricks, Cableways, Concrete Mixers, Coal Mine Hoists and Machinery Generally. I handle both New and Second-hand.

WILLIS SHAW, - - - - 171 La Salle St., CHICAGO

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.
Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.

We want an agent in every factory. Liberal pay. Will not interfere in the least with present duties, Address A. D,, Care Popular Mechanics.

Please mention Popular Mechanics when writing advertisers.

The Ever-Ready Pocket Flash Light

Price $1.60, Prepaid

EMPIRE ELECTRIC SUPPLY CO.

57 West Jackson Boulevard, - - CHICAGO, ILL.

The World's Headquarters for

ELECTRIC NOVELTIES AND SUPPLIES

If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3 00
Battery Hanging Lamp	10.00
Telephone, complete, $2.50,	5.95
Electric Door Bells	1.00
Electric Carriage Lamps	5.00
Hylo Turn-Down Lamps	.60
$8.00 Medical Batteries	3.95
$12.00 Belt, with Suspensary	2.50
Telegraph Outfits	2.25
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights	3.00
Electric Railway	2.75
Pocket Flash Lights	1.50
Necktie Lights 75 cents to	3.00

SEND FOR FREE BOOK

$3 Electric Hand Lantern **Agents Wanted**

OHIO ELECTRIC WORKS - - - Cleveland, Ohio

ELECTRICAL BARGAINS

"Magic" Search Light (like cut)	$2.00
Vest-Pocket Light	1.50
Telephone, complete	2.50
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	90c. and up
Battery Motors	75c. to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Library Lamps	3.00
Electric Carriage Lamps	5.00
Electric Reading Lamps	5 00
Miniature Electric Railways	3.25
Electric Scarf-Pins	1.50

Our Free Catalog

describes many other electric novelties. We promptly refund money if dissatisfied.

AGENTS WANTED

These novelties sell on sight and are easily shown. Everybody is interested in some of them. We want good, live, responsible agents in every place, big or small, and there's an interesting proposition ready. All particulars for a postal.

J. W. SCRIBNER & CO., 161 Niagara St., Tonawanda, N.Y.

"RED CROSS" LUBRICANT FOR COMMUTATORS.

The Biggest Little Thing on the Market

A SCIENTIFIC PREPARATION

very different from all so called compounds

Endorsed by over 15,000 prominent engineers and electricians throughout the United States, Canada, England, Holland and Germany.

It Lubricates, preventing wear and cutting, and dissipates any sparks preventing eating away of commutator bars and brushes.

Full size sticks, 5 inches long, 7-8 inch in diameter, packed in neat box at $5.00 per dozen. Single sticks 50c each. Delivered anywhere in the United States. LARGE SAMPLE, 15c

MANUFACTURED BY

HART & COMPANY, Inc.

894 Monadnock Building, Chicago, U. S. A.

LIKES IT BETTER THAN ALL THE REST.

Publisher Popular Mechanics: Your notice came this morning and I comply with your request at once. I would have all my other papers stopped rather than Popular Mechanics and the whole family are in the same fix. With best wishes for the best journal printed, I am very truly,

James H. Angell, Stockwell, Cal.

WHAT TOWN WANTS A BIG FACTORY?

The stockholders of the Otto Gas Engine Works have decided to increase the capital of the corporation from $600,000 to $2,500,000 and build a large, new plant just as soon as the management can find a suitable site for the purpose.

Large gas engines, producer gas plants, launches and marine engines, gasoline hoists, compressors and other adaptations of the gas engine will be built promptly at the new plant.

A suitable site must contain not less than thirty acres, must be located on a good water front and must have good railroad facilities.

SHALLOW SEAS NEAR SOUTH POLE.

The German antarctic exploration expedition, headed by Prof. Drygalski, has returned to Keil, after a successful voyage in the steamer Gauss, which Commander Peary may purchase for his North Pole exploration. The expedition carried on deep sea studies continuously during the journeys to and from the antarctic regions, showing that shallow seas prevail generally around the South Pole. The expedition found the temperature, ranging to 60 degrees below zero, to be without inconvenience.

WOULD RECOVER XERXES' FLEET.

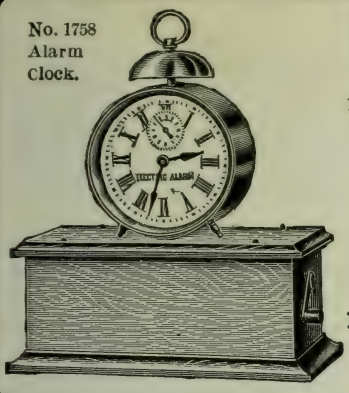
A search is to be made for the lost fleet of Xerxes, the ships of which have lain at the bottom of the sea for something like 2,300 years. Arrangements have been made in Athens by which the search is to be instituted along the sea's bed with a newly invented marine instrument of great power, called the hydroscope. By means of the same instrument efforts will be made to recover the ship chartered by Pompey to convey to Rome art treasures which he had seized at Athens. This ship was wrecked in the archipelago about 1,950 years ago.

WOULD TAX FOREIGN-MADE ELECTRICITY.

The question, "Can electricity be taxed by the Federal government?" is causing the treasury officials some annoyance. The establishment along the Canadian frontier, especially along the Canadian side of the Niagara river, of large generating plants for the production of electricity, mostly to be used in the United States, has raised the question of whether this foreign product can be subjected to a customs tax upon crossing the frontier. There has been no attempt so far to collect a duty upon foreign-made electricity, but the proprietors of the large generating plants, mostly American capitalists, are becoming apprehensive that their competition will force domestic producers to appeal for protection to the taxing power of the federal government.

Fred S. Whipple, a Michigan Central trainmaster, has invented a heating device which is intended to keep switches free from snow and ice and thus obviate the employment of many men to do this work.

No. 1758 Alarm Clock.



Electrical Novelties and Supplies

SPECIAL NET PRICES

No. 1561. Short line telephone, Ea. @$2.50
2204. Home Medical Apparatus - - - " 3.25
2215. Anti-Doc. Medical Apparatus - - - " 2.00
2240. Little Giant Medical Apparatus - - - " 1.35
1762. Electric Door Bell Outfit, complete - - " .55
Eureka Pocket Flash Lights " 1.25
Mesco Dry Batteries @10 1-2c.
178. Eureka Telegraph Instruments - - - " 1.00
3 inch Iron Box Bells - " .16

No. 18. Annunciator Wire, per lb. - - - Ea. @ $0.22

Long Distance Bridging Telephones

With 1600. Ohm Ringers, 50,000 Ohm Generators, fully guaranteed, complete Ea. @$11.00
Same with 100,000 Ohm Generators - - - " 12.00
1758. Early Riser's Electric Alarm Clock - - " 1.90

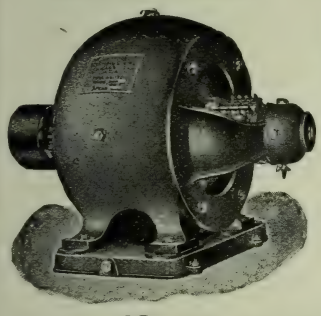
We have many other equally as attractive prices to offer.

SEND FOR NO. 16 CATALOGUE

MANHATTAN ELECTRICAL SUPPLY CO.

The Largest Manufacturers and Dealers in Electrical Supplies in America

32 Cortlandt St, 39 Dey St., New York 200 5th Ave., Chicago



Electrical Construction.....

DYNAMOS, MOTORS, METERS
ARC LAMPS, SWITCHBOARDS
RHEOSTATS and WIRING

Repairing of all kinds

N. W. YOUNG, 52 West Adams Street, **Chicago**

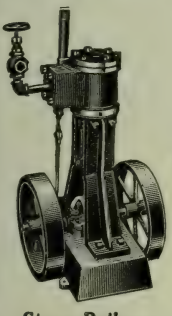
Telephone, FRANKLIN 231

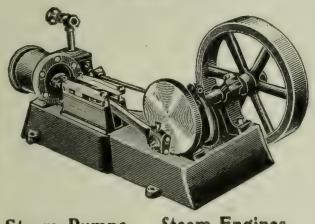
BE YOUR OWN ENGINEER

We Can Furnish You With

ENGINES

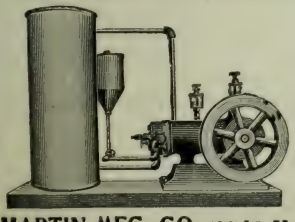
1-8 H. P. UP.

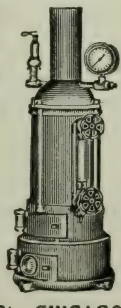




Steam Boilers, Steam Pumps, Steam Engines, Gas and Gasoline Engines

For Stationary, Marine and Automobile use. Dynamos, Motors, Electric Fans, Electric Novelties, Batteries & Supplies, Individual Electric Lighting Outfits, 8 to 100 Light. Our new Illust'd catalog sent postpaid 6c.





MARTIN MFG. CO. 180 W. Madison St., CHICAGO

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

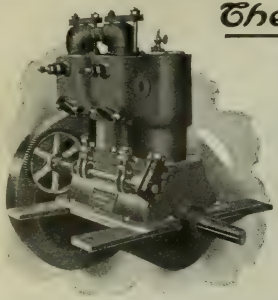
Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

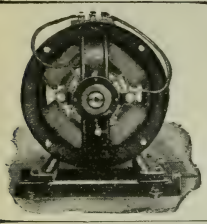


The Hoffman Motors

ANY HORSE POWER FOR ANY PURPOSE

Write for CATALOG . . AND . . PRICES

H. L. Hoffman Motor Company
28 West Randolph St., - - Chicago



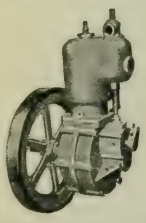
Peerless Electric Co.

ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET

141-143 South Clinton Street
'Phone Main 1025 **Chicago**

Marine Engines

1 H. P.

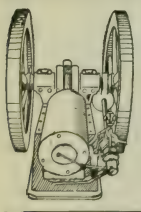


Especially adapted to apply to boats 14 to 16 feet long, complete with reversible propeller. Batteries, carburator, spark coil plug and muffler. **Price only $65.00.**

Transmission Gears	**Bodies**
Sparking Plugs	**Spark Coils**
Contact Boxes	**Tanks**
Ignition Set	**Hoods**
Running Gears	**Pumps**
Carburators	**Oil Cups**
Pulley Rims	**Mufflers**
Motor Cycles	**Wheels**

We also Sell the Castings and Blue Prints for building th se Motors. Price, $12.00 per set

GRAVES MOTOR MFG. CO., St. Paul, Minn.



Gasoline Engines

"HONESTY IS THE BEST POLICY"

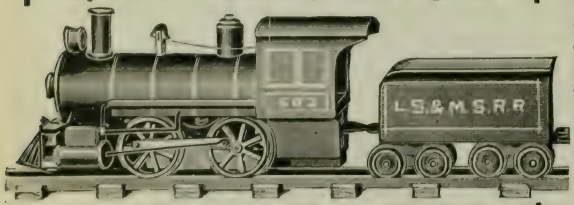
THIS IS OUR POLICY

LET US PROVE IT TO YOU
Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY
25 West Randolph Street, Chicago

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,
262 E. Clifton Ave. Cincinnati, Ohio

SPIDER DISABLES FIRE ALARM SYSTEM.

That of Entire Town of Bayonne, N. J., Short-Circuited by an Insect in the Transmitter Room.

The entire fire alarm system of Bayonne, N. J., was disabled by a single spider. The insect was found in the transmitter room, where all the wires converge into a network. Henry D. Kernaghan, who has charge of the alarm system, made the discovery. He said:

"Late at night one tap was struck. I got out of bed and went all over the five circuits, but failed to find the cause of the trouble. The system was plainly out of order and I was at a loss to know why. I finally turned my attention to the inside and found every indicator in the department in perfect running order. I went to the city hall and looked into the battery room. Tests proved everything O. K. there. I then went to the transmitter room and looked carefully over every part. To my astonishment the cause of all the trouble was before me. It was nothing more nor less than a big, black hairy spider. It was dead and hanging to the wires in such a manner that its body 'short-circuited' the whole system. The blame thing had evidently mistaken the network of wires for a new sort of web and was killed while doing a tight wire act over it."

WHAT THE CANAL MEANS.

The Panama canal will double the strength of the American navy by enabling ships to be thrown from one American coast to the other with small delay. It will serve in binding the Philippines and Hawaii more closely to the United States, not only to the western, but also to the eastern and southern coasts of the American continent. To meet the water competition the transcontinental railroads will have to reduce their long haul and, sympathetically, their short haul freight rates. Lord Roseberry has said: "Party divisions should cease at the shore."

MAKING COTTON FIREPROOF.

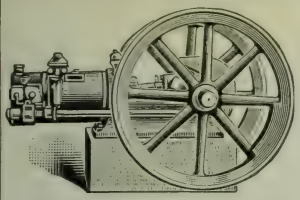
A method of decreasing the inflammability of cotton goods has been patented in England. It consists of impregnating the cotton with silicate of alumina. The goods are passed first through a 20 per cent solution of silicate of soda, then dried and passed through a 10 per cent solution of aluminate of soda. The precipitation of silicate of alumina which takes place in the second bath sets free caustic soda, which is neutralized with an ordinary finishng soluton or a solution of Epsom salts. The order of the first two baths may be reversed and carbonate of ammonia may be used for neutralizing the caustic soda.

TO RAISE SEALS IN LAKE MICHIGAN.

It is reported from Milwaukee that a company has been organized in Wisconsin for the purpose of stocking Lake Michigan with fur-bearing seals. The movement is said to be headed by former Lieutenant-Governor Fifield, assisted by Seban Malaroff, a Russian sailor, who claims that the climatic conditions are ideal and that large profits could be realized from the industry.

RIVER OF REAL INK.

Arizona has a river of ink. It flows forty miles through the sand and empties into the Gila river. Its source is a spring which sends forth a deep blue-black liquid that will die anything dipped into it. It is used by many residents of that section as a writing fluid.



"OTTO" means Economy in Gas and Gasoline Engines.

Fuel economy is due to correct design.

Economy in the use of fuel.

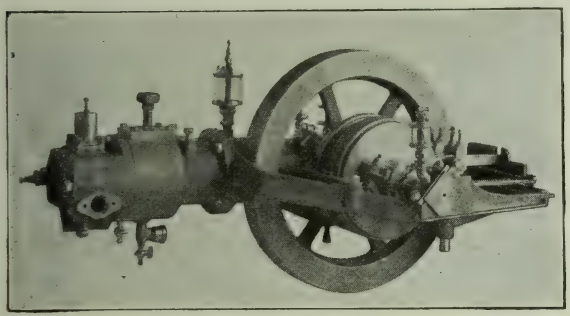
Economy in the cost of maintenance.

Economy in first cost because of great durability.

Slight cost of maintenance and great length of life are due to good materials and fine workmanship; cold facts that 75,000 users stand ready to vouch for and the logical results of 28 years of experience.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street MINNEAPOLIS: 318 3rd Street OMAHA: 1108 Farnum St.



ENGINES - -

Vertical and Horizontal

4 to 20 Horse-Power for

AUTOMOBILES

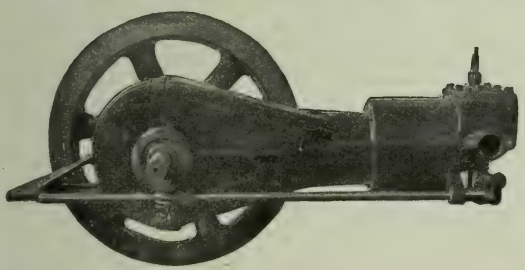
with and without Transmission

Send 3c. Stamp for Catalogue.

The P. J. Dasey Co.

Marine Building Chicago

WE BUILD THEM



THE MURRAY AUTOMOBILE MARINE and STATIONARY GASOLINE

ENGINES

Transmission, Gears, Carburetters, Pumps, Mufflers, etc. : : : : : : :

Write for circular and prices before ordering.

W. B. MURRAY, 1253 Milwaukee Ave., CHICAGO, ILL.

GAS and GASOLINE ENGINES

1 H. P. UP. Cheap, safe power for the **Farm, Factory or Shop**

Dynamos and Motors, 1-16 H. P. up.

Complete Outfits for small Lighting Plants.
We also have for immediate delivery:

Volt Ammeters	Light Brackets	Medical Batteries
Storage Batteries	Magnetos	Automobile Engines
Telegraph Outfits	Telephones	Electric Bells and Outfits
Marine Engines	Sparkers	Experim'tal Elec. Apparatus
Pumping Outfits	Flash Lights	Miniature Electric Rys.
	Electric Sign Letters	

Small Dynamos and Motor Castings and finished parts for complete construction, Gas and Gasoline Engines Rough Castings to build, 1-2 H.-P. up.

Send for Complete Catalog. **L. W. GILLESPIE, Marion, Ind.**

CHICAGO SCHOOL of ENGINEERING
ALL INSTRUCTION PERSONAL
An evening school giving instruction in Engineering subjects—teaching the latest and most approved practice.
Write for Information
304 CHICAGO OPERA HOUSE BUILDING

LAW **Taught by Mail.** Students prepared for admission to the bar in all States. Individual instruction. Send for catalogue.
MARSHALL D. EWELL, M. D., L. L. D., Pres.
Home Study Law School : : 627-59 Clark Street, Chicago.

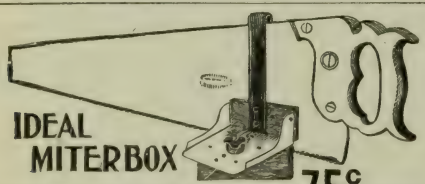
Electrical Books and Novelties
CATALOGUE FREE
Bubier's Popular Electrician, 50 cents per year; sample copy, 5 cents post paid; eight books 10 cents each. How to make a Dynamo, Motor, Electric Bell, Telegraph Instrument, Induction Coil, Telephone, Storage Battery, Talking Machine. Fully illustrated, **TEN CENTS EACH**. Dynamo and Motor Castings.
BUBIER PUBLISHING CO., Box P, Lynn, Mass.

TELEGRAPHY
Telegraphers' Penmanship and Typewriting
COMBINED IN ONE TUITION
We are unable to meet the demands of the railroads for our graduates Positions guaranteed to all our students. Send for catalog.
The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

For Mailing Lists, Addressing, Imitation Letters and all Circular Work, address
TRADE CIRCULAR ADDRESSING CO.
125 Clark Street, Chicago
Ask for 50 page Catalogue of Lists.

PLUMBING SUPPLIES
1-3 Saved by trading on our wholesale prices. Full line in stock. Quality guaranteed. Shipments prompt. Let us describe and quote prices on what you want.

B. P. KAROL, 231-235 W. Harrison St., CHICAGO, ILL.


IDEAL MITERBOX
Accurate, light and compact.
Agents Wanted.
75c EACH
IDEAL TOOL CO., 3783 High St., Denver, Colo.

FOOT and POWER
AND TURRET LATHES, PLANERS
SHAPERS AND DRILL PRESSES : : : :
SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

SURGICAL KNIVES SHARPENED WITH ALUMINUM.

Aluminum has been found to give a remarkably keen edge to surgical knives, razors and other keen edged steel instruments. The action of a smooth piece of aluminum when rubbed on the steel edge is to produce an edge which cannot be secured on the best hone. The explanation is that the aluminum being the softer metal, with a sort of greasy feeling, clings to the steel and fills the minute saw-like edges of the blade.

SIAMESE WANT MODERN WIND MOTORS.

There is a good opening for modern wind mills in Siam. Siamese experts have advocated wind motors for watering the rice fields. If the rice fields could be properly watered the Siamese would have three harvests instead of one, as at present. The motor must be made entirely of galvanized steel with a diameter of about ten feet. At the same time it might be so constructed that it could not only raise the water for irrigating purposes but also made to supply power for husking and grinding the rice. The dry season in Siam lasts from November till May and there is plenty of wind during that period.

SLEEPING CAR SEATS TO BE IMPROVED.

The seats in Pullman sleeping cars are at last to be changed. In cars hereafter built there will be a space left under each seat where hand bags, suit cases, etc., can be stowed away. The steam coils under the seat will be removed and placed along the sides of the car.

WALKING TELEPHONE DIRECTORY.

There is a blind music teacher in the city of Indianapolis who possesses a remarkable memory. He has already committed to memory 2,100 names and telephone calls of the telephone directory in that place and believes he can master the entire list of many thousand names.

A TAX ON WEIGHT.

In a certain city in Sweden a law has been passed which is intended to discourage people who are inclined to become fleshy. All persons whose weight is above normal will be required to pay a graded tax each year. The scheme is not primarily for revenue, but the reformers argue that people eat too much and exercise too little, and that an improvement in these two respects will tend to benefit the entire community.

STUDIED THE HEART TO KILL.

It is related that Dr. Nuhn, the professor of anatomy, at Heidelberg, was much surprised one day when a banker, usually unsociable, sat with him in a railway car and, after a pleasant chat, asked him all sorts of questions, especially about the anatomy of the heart. The next day he called, by permission, and watched the professor dissecting one of these organs. Then he drove home, and a few hours later it became known that he had committed suicide by skillfully plunging a dagger into his heart.

The Westinghouse Electric & Manufacturing Company has purchased a controlling interest in the Lackawanna & Wyoming Valley Rapid Transit Company for $6,000,000. The Westinghouse Company will equip the road electrically to demonstrate the advantages of electricity as a motive power for freight and passenger service.

"SHORT TIME TO MAKE A MEETING POINT."—Haste is imperative, for the snow is falling in perilous quantity, and the tracks may be blocked before the end of the division is reached. Such thoughts filled the mind of many a trainman and the scene the illustration depicts was of frequent recurrence in the western states of America during the month of January. The picture from Railroad Trainmen's Journal. It is so typical of many such scenes that dozens of trainmen will at once recognize it as the identical storm they experienced at such and such a place. The month of January in the west was especially perilous for railway traffic on account of the unprecedented heavy fall of snow. O'd trainmen say they never knew snow to come down in such blinding magnitude as it did in many sections. Wrecks were numerous; great property loss was experienced and many lives were lost. During some of the storms in mid-day it would turn as dark as night because of the lowering skies and the impenetrable thickness of the area of descending snowflakes.

EASY ELECTRICAL EXPERIMENTS

A SIMPLE ELECTRIC LAMP OUTFIT.

The electric lamp shown in the cut below is a very serviceable device. Used in connection with a clock which may be placed behind the lamp, it is possible to tell the time in the darkest night, and that without moving from one's bed, if it is so desired. Small electric lamps suitable for such an outfit may be purchased quite cheaply. For the outfit to be described, a ½ candle power lamp requiring 4 volts should be purchased, together with a small porcelain base for holding the lamp. Any large dealer in electrical supplies should be able to furnish these.

The amateur will only need to construct a suitable battery for running the lamp, and a wooden base for holding the battery and

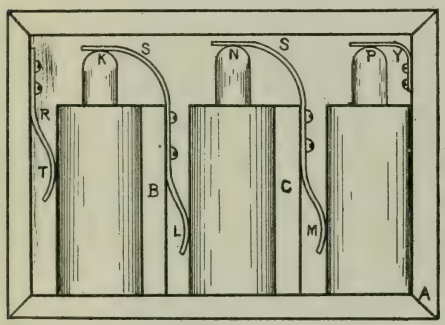


FIG. 1.

for supporting the lamp and the clock. Dry cells are used, of which three will be required. They may be constructed as follows: From a piece of sheet zinc cut out a piece 4 inches long by 3 inches wide. Roll this into a smooth cylinder three inches long by 1⅛ inches in external diameter, and solder the overlapping edges. Then cut out a circular piece of zinc 1 3-16 inches in diameter, and solder it on to one end of the cylinder, so as to form a tight zinc cup, 3 inches in height and water tight.

Now take a piece of electric lamp carbon such as may be picked up in the street after the lamp trimmer has made his rounds. This piece should be 3¼ inches in length. Select one which seems to have a thick plating of copper, and file off this copper except at one end. The copper is left on here, so as to enable a good contact to be made with the carbon. From the sole of an old rubber shoe cut out some rubber rings which will just fit tightly over the carbons and slip smoothly inside the zinc cylinder. These ruber rings are to keep the carbon from touching the zinc at any point. Immerse the copper plated ends of the carbons in a dish of boiling hot paraffine wax for one hour, the paraffine extending for ¾ inch from the end. This process is very necessary, and care should be taken to see that the pores of the carbon at this end are completely filled with the boiling wax. Three carbons, three zinc cups and six washers will be required in all. We must next make a mixture or paste with which to fill the cells. This paste is made up by mixing ¼ pound zinc oxide, 6 oz. of sal-ammoniac, ¼ lb. plaster of paris, ¼ pound chloride of zinc and ½ pint of water. As soon as the paste is mixed, it should be put into the zinc cups. First put in a thin layer in the bot-

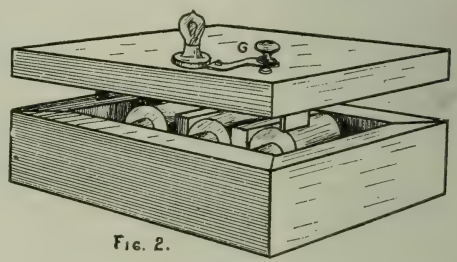


FIG. 2.

tom of each cup. Then place one of the rubber washers on the uncoated end of one of the carbons, and insert it and the washer into the cup, leaving ⅝ inch of the carbon projecting from the top of the cup. Then commence to put in the paste, pushing it in with a stick, until it is within ½ inch of the top. Then push a second rubber washer around the carbon rod and into the zinc cup, until it rests on the top of the paste. Now set the cell to one side, and proceed to fill the remaining two in a like manner. When the three cells are filled, melt together in a ladle ½ pound of rosin and 2 oz. of beeswax. This forms a kind of sealing wax which should be poured over the top of the paste, effectually sealing the cells. If it is possible to secure some pitch, it may be used instead of this wax, with better results. The cells are now complete and ready for service.

A neat wooden base should next be made for holding the cells. A plan of this base is

shown in Fig. 1. A piece of whitewood 5 by 6 by ½ inch should be carefully finished up. Then cut out two strips of the same material 5 by 1⅛ by 12 inches, and two strips 6¼ by 1⅛ by ½ inches. These are for forming the sides of a shallow box of which the large piece just mentioned is the base. Cut the ends of the strips in a mitre box as shown at A, Fig. 1, and fasten them to the base with glue and brads, making a box whose inside dimensions are 4 by 5¼ by 1⅛ inches. Now cut out two more strips 3 by 1⅛ by ½ inches and finish them so that they may be inserted in the inside of our box as shown at B and C. Before glueing them in place, however, two springs shown at S should be made. These are made from heavy spring brass, and are ½ inch wide and 4½ inches long. At one end they are bent around in a smooth bend so as to make them of the shape shown at S. Then the long end of the spring is fastened to the side of the strips B and C, in such a manner that when these strips are in place the springs will just clear the side of the box at K and N. The springs are fastened to B and C by two screws, which enter B and C near the end nearest the bend. Then the straight ends of the springs are bent slightly outward, as shown at L and M.

These springs are for making connections between the cells. The wooden strips B and C are inserted, so as to divide the box into three equal compartments. Then when a cell is slipped into each of these compartments, the carbon of cell number one should make contact with the first spring at K. The other end of this spring should press firmly against the zinc of cell number two. Likewise the carbon of cell number two is connected at N to the second spring, which in turn connects with the zinc of number three at M. To complete the connections, a spring shown at Y should be provided, and also one shown at R, the former making contact with the carbon of the third cell, the latter with the zinc of the first cell.

A cover to fit the box should be made, with two brass lugs projecting from the under side so as to press against Y and R, the brass lugs connecting by wires to the terminals of the little lamp, which is mounted on the top of the cover as shown in Fig. 2. One of these connecting wires should, however, pass through a contact key shown at G, Fig. 2, so that the lamp will be lighted only when the key is pressed.

The life of the batteries will depend upon how much they are used. The lamp should not be burned continuously but only for the shortest possible time. Instead of the key on the cover of the box, a key located at any convenient place in the room may be used.

CHARCOAL BURNING IN NEW ENGLAND.

Burning charcoal is quite an extensive industry in many parts of New England. In certain districts there may be found old men engaged in the work, whose fathers and grandfathers before them conducted the same occupation in the same place. The same primitive method of "setting up" a pit that was employed a hundred years ago, is described in the Rural New Yorker. Sticks of pine, oak, alder, birch or hemlock,

Charcoal Pit

are cut into pieces about seven feet long, and set up on end to form a cone from eight to ten feet high, pointed at the top, where a hole is left to let out the smoke. The pile is then covered with ferns and leaves, and over these is shoveled earth to a height of about six feet. The remainder of the pile is covered with heavy sod. Two rows of small holes to let in air are made, the aperatures about one foot apart and extending all the way around the kiln.

When all is ready some blazing bark is dropped through the hole at the top. The pit must be watched night and day. If blue smoke appears it means the fire is burning too rapidly and some of the holes are closed. In ten or twelve days the burn is complete and the cover is removed and the charcoal taken out, cooled, and is ready for market. Alder makes the best and hemlock the poorest grade of charcoal.

When you want anything and don't know where to get it, write Popular Mechanics.

MECHANICS FOR YOUNG AMERICA

Coasting Sleds, Chair Sleighs, Toboggan Slides, Skis and How to Make Them

Make your own sleds, boys! There is no use in buying them, because your hand-made sled is probably better than any purchased one and then you can take so much more pride in it when you know it is of your own construction. There are so many different designs of sleds that can be made by hand that the matter can be left almost entirely

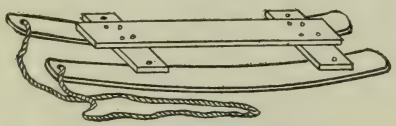


Fig. 1.—Barrel Stave Sled

to your own ingenuity. You can make one like the bought sleds and face the runners with pieces of an iron hoop which will answer every purpose. A good sled for coasting consists simply of two barrel staves and three pieces of board as shown in the picture, Fig. 1. No bought sled will equal it for coasting and it is also just the thing for carrying loads of snow for building snow houses. The method of its construction is so simple that no other description is needed than the picture. You can make a chair-sleigh out of this by fitting a chair on the cross board instead of the long top board or it will be still stronger if the top board is allowed to remain, and then you will have a device that can readily again be transformed into a coasting sled. In making the chair-sleigh it is necessary, in order to hold the chair in place, to nail four L-shaped blocks on the cross boards, one for each leg

Chair Sleigh

Fig. 2.—Folding Chair Sleigh Bottom

of the chair. Skating along over the ice and pushing the chair in front of him the proud possessor of a chair-sleigh may take his mother, grown sister or lady friend with him on his outings, and permit her to ride in the chair.

FOLDING CHAIR SLEIGH.

A folding chair sleigh is even more enjoyable and convenient than the device just described. If the ice pond is far from home this may be placed under your arm and carried where you like.

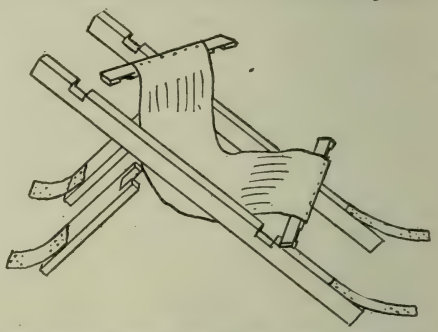


Fig. 3.—Folding Chair Sleigh.—Top Parts Disconnected

The illustrations, Figs. 2 and 3, show all the parts as they should look before being joined together. The seat may be made of

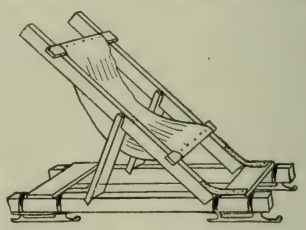


Fig. 4.—Folding Chair Sleigh Open

a piece of canvas or carpet. The hinges are of leather. Fig. 4 shows the folding chair sleigh after it has been put together. Skates are employed for the runners. The skates may be strapped on or taken off whenever

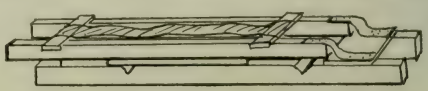


Fig. 5.—Folding Chair Sleigh Closed

desired. When the chair is lifted the supports slip from the notches on the side bars

and fall on the runner bars. The chair is then folded up so that it can be carried by a small boy. With regular metal hinges and light timbers a very handsome chair can be constructed that will also afford an ornamental lawn chair for summer.

THE TOBAGGAN SLED.

When the snow is very deep a toboggan sled is the thing for real sport. The runners of the ordinary sled break through the crust of the deep snow, blocking the progress, and spoiling the fun. The toboggan sled, with its broad, smooth bottom, glides along over the soft surface with perfect ease.

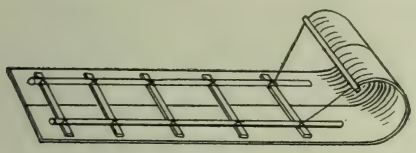


Fig. 6.—The Toboggan

To make the toboggan sled, secure two boards each ten feet long and one foot wide and so thin that they can be easily bent. Place the boards beside each other and join them together with cross sticks. Screw the boards to the cross stick from the bottom and be sure that the heads of the screws are buried deep enough in the wood to not protrude, so that the bottom will present an absolutely smooth surface to the snow. Fasten two side bars to the top of the cross sticks and screw them firmly. In some instances the timbers are fastened together by strings, a groove being cut in the bottom of the boards so as to keep the strings from protruding and being ground to pieces. After the side bars are securely fastened, bend the ends of the boards over and tie them to the ends of the front cross bar to hold them in position. See Fig. 6. The strings for keeping the boards bent must be very strong. Pieces of stout wire, or a slender steel rod, are even better. The toboggan slide is the favored device of sport among the boys in Canada, where nearly every boy knows how to make them.

THE NORWEGIAN SKI.

You have often read of the ski, the snowshoe used by the Norwegians and other people living in the far north. With them the men and women glide down the snow-covered mountain sides, leap across ditches, run races and have all kinds of sport. They are just as amusing to the American boy who has ever learned to manipulate them, and it is wonderful how much skill can be attained in their use. Any boy with a little mechanical ingenuity can make a pair of skis (pronounced skees). They can be made from two barrel staves. Select staves of straight grained wood. Sharpen the ends of each and score each end by cutting grooves in the wood, as shown in the cut, Fig. 7. A pocket knife or small gouge will suffice for

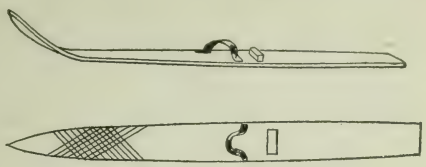


Fig. 7.—Skis

this work. Then smear the end of the staves with oil and hold them close to a hot fire until they can be bent so as to tip the toes upward, as shown in the picture, Fig. 7. Then with a cord bind the staves as they are bent and permit them to remain thus tied until they retain the curved form of their own accord. Now screw on top of each ski a little block, just broad and high enough to fit in front of the heels of your shoe. Fasten a strap in front of each block through which to slip your toes, and the skis are made. The inside of the shoe heel should press firmly against the block and the toe be held tightly under the strap. This will keep the skis on your feet. Now procure a stick with which to steer and hunt a snow bank. At first you will afford more amusement to onlookers than to yourself, for the skis have a way of trying to run in opposite directions, crosswise and various ways, but with practice you will soon become expert in their manipulation.

The building of a Canadian armed cruiser for the Great Lakes has caused comment on the treaty supposed to restrict such a movement.

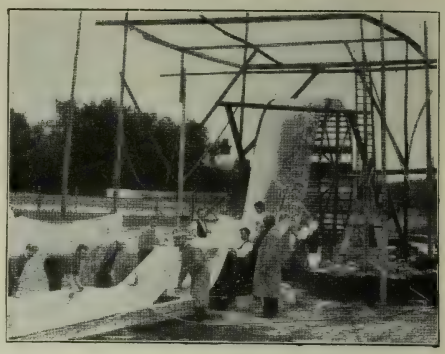
John D. Rockefeller's gift of twelve millions to the University of Chicago should be appreciated. It takes John nearly twlve weeks' hard work to earn that much money.

The Swiss government is considering the advisability of substituting electricity for steam as a motive power on all the railroads of that country.

Largest Photograph in the World

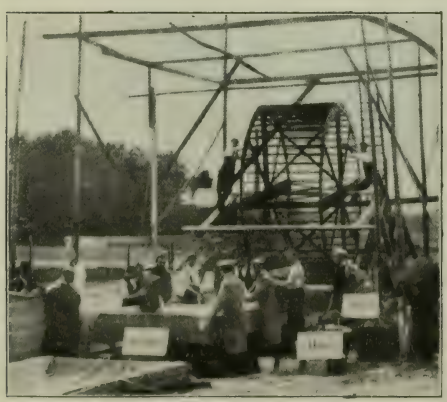
Special Machinery Built for Producing a Picture 12 Yards Long and 1 1-2 Yards High

A photograph 12 yards long and 1½ yards high has recently been produced in Naples. It is the largest photograph in the world and the marvel of the art in all lands. The feat was performed by the New Photographic Company of Berlin. It is a photograph of the Bay of Naples and was taken from Castello Marino, the highest point of the mountains surrounding Naples. It shows the bay from Vesuvius to Capri. Six plates were used in making the photograph. The image was enlarged direct on to bromide paper, each section measuring 1½ yards by 2 yards. The development had to be done in the open air by night. Only two copies of the remarkable picture were made. One is to be exhibited in Dresden and the other at the St. Louis exposition.



Method of Washing Print in Specially Constructed Vat

Retouching by Night



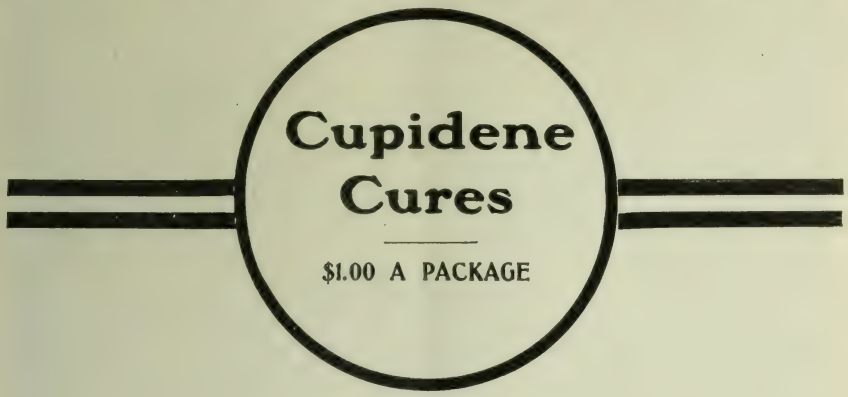
Preparations for Fixing the Great Winding Wheel

In producing this photograph it was necessary to make special machinery, unlike any ever used by a photographer before. It was necessary to climb up on ladders to perform the work of developing. A great winding wheel was constructed on which to roll the photograph while it was being developed. Four stages in the process of preparing the picture are shown in the illustrations.

Great coal beds have been discovered in Eastern Asia—the richest in the world.

Write for Popular Mechanics' premium list.

Tobacco Weak Heart



There comes a time when the cigarette must go—when the weakness must be overcome. Every man owes it to himself, to his futurity to be strong, vigorous, lusty. Now you have broken the laws of nature, broken the rules of health, laid violent hands on the powerful organs of the body, yes, you must expect to be weak. You smoke tobacco beyond the dictates of prudence, burn your candle at both ends, and even in the middle, then you become a poor, miserable man. You have sown the seeds of violence, you must reap the harvest of weakness.

THERE IS A CHANCE for you; just one chance. You can overcome your follies, you can stop the losses of night and day, you can be made well—by the use of **CUPIDENE**. There is only one and one only **CUPIDENE**. It is the **WEAK MAN'S** remedy. **CUPIDENE** cures prematureness, varicocele, hydrocele, knotted veins. **CUPIDENE** cures the mind that is frail, the body that is weak; cures the bleary eye, the all-gone man. **CUPIDENE** lifts you out of the rut. Puts vim and life into your entire system.

NOTE THE SYMPTOMS

CUPIDENE cures dizziness, mental incapacity, fits of weakness, despondency, rush of blood to the head, giddiness, loss of sleep, purility, hypochondria, lack of power, knocking knees, irritability, night sweats, hot and cold flashes, kidney and bladder disorders, swelling under eyes, puffiness of eyes, poor circulation of the blood, numbness, enlargment of the seminal ducts. **CUPIDENE** cures just as certain as you are a weak man. Give **CUPIDENE** a fair, impartial trial. Don't trifle with yourself any more. **CUPIDENE** is sold under a guarantee. **CUPIDENE** is O.K. Try this man's remedy. 20 years' of use, 20 years' of testimonials.

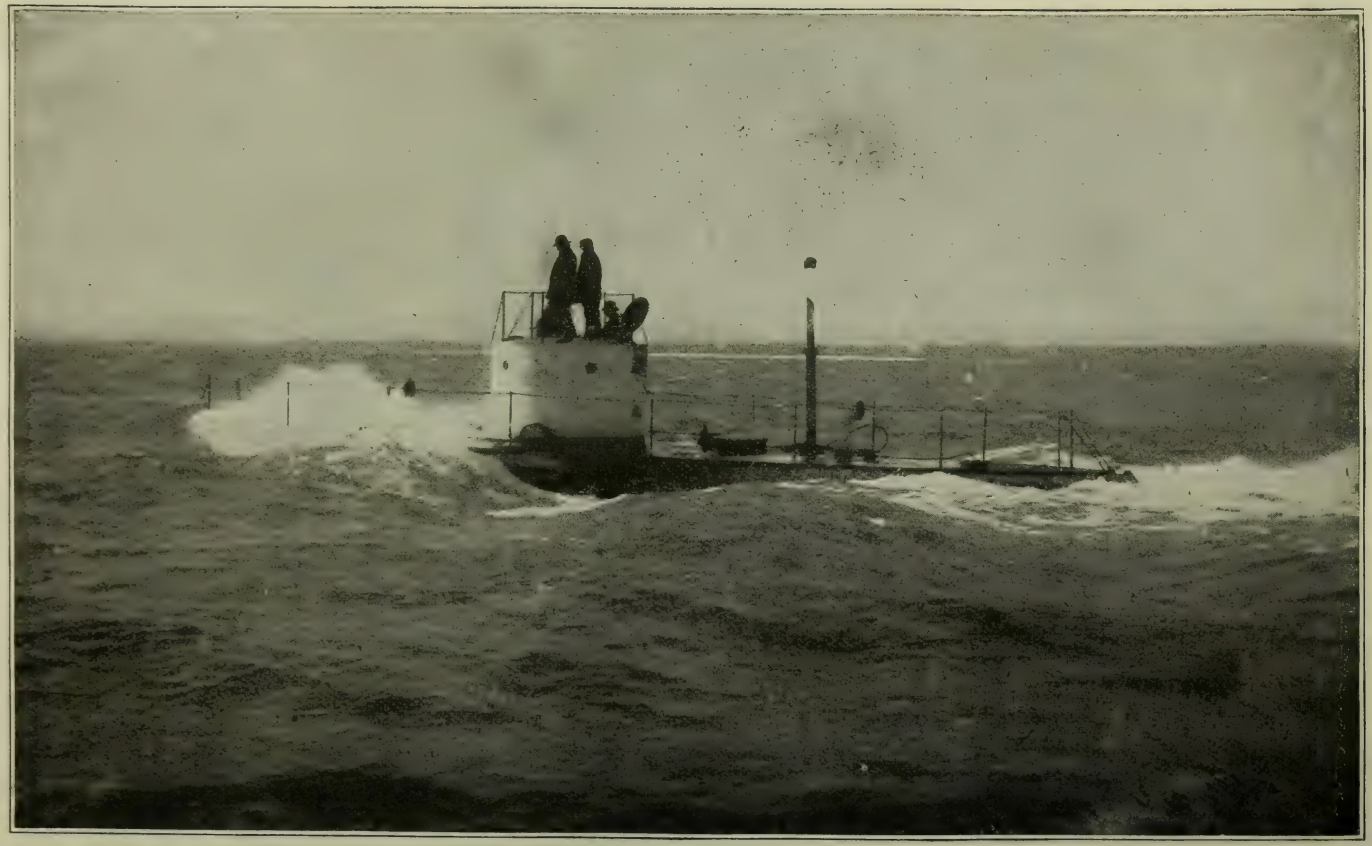
CUPIDENE IS SOLD FOR JUST $1.00 PER PACKAGE. SIX PACKAGES $5.00

SEND FOR FREE CIRCULARS
BOOK OF CUPIDENE CURES FREE

WRITE PRIVATELY

Davol Medicine Company

40 ELLIS STREET, SAN FRANCISCO, CAL.



Submarine Boat "Protector" in Cruising Condition

Popular Mechanics

Vol. 6. No. 3. CHICAGO, MARCH, 1904. 10 Cents a copy. $1.00 a year.

America's Wonderful Submarine Automobile Boat

The Protector Floats, Dives and Rolls Along the Bottom of the Sea on Wheels as Desired--Submarine Cruiser Will be Next

Editor's Note:. The destructive work done by the Japanese submarine boats in the attack on Russia's ships at Port Arthur and the remarkable success that has recently been attained by United States Combination Submarine Boat "Protector," furnish convincing proof that the under-water boat is a practicable and powerful implement of war and mark a new era in the construction of this type of vessel. The "Protector" is more formidable than any submarine Japan may possess. Provided with wheels for traveling on the bottom of the sea and with newly designed machinery that admits partial or total submergence at will and propels the vessel rapidly and accurately on or under water, the "Protector" might be called a combination submarine automobile and submarine boat.

Until recently "submarines" have been experimental constructions. The "Protector," more than the Japanese boats, places them in the list of real fighting vessels that are to be counted among the most formidable equipments of the navy. Not only this, but it is believed that the "Protector's" success has paved the way for the advent of an entirely new type of war vessel—the "submarine cruiser"—designed to travel in deep water and attack the enemy in transit and a craft of far greater size and destructiveness than the submarine torpedo boat.

Elated over the success of the "Protector," the United States contemplates the immediate construction of other vessels of her type and with these to guard the coast it is believed America's harbors will be impregnable to any possible assault of the most powerful fleets of the combined nations of the world.

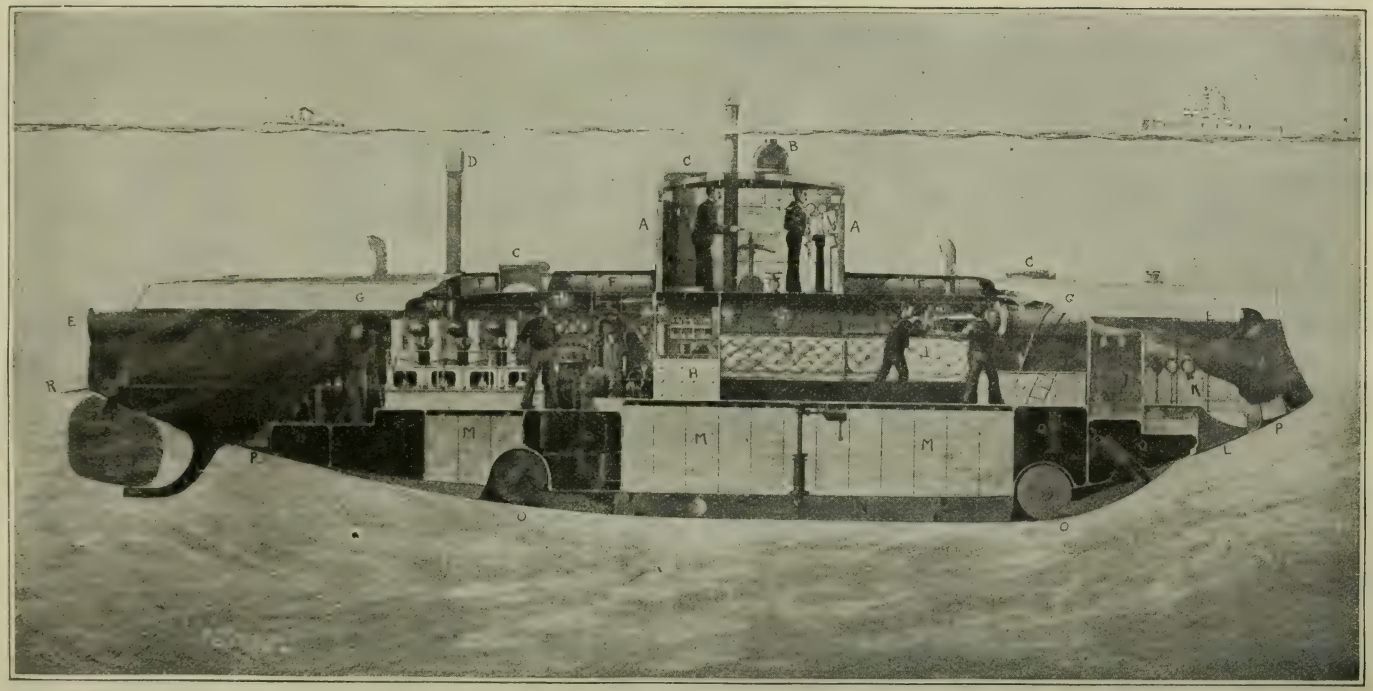
Popular Mechanics has been so fortunate as to obtain a description of the new submarine by Lieut. John Halligan, Jr., the well known naval expert, who has made many trips under the sea aboard the boat and who, probably, is better capacitated to write on the subject than any other authority.. Lieut. Halligan is a regular contributor to the Journal of the American Society of Naval Engineers, the official organ of the Society and the world's authority on American naval affairs.

By Lieutenant John Halligan, Jr., Member of the American Society of Naval Engineers

The submarine, when within torpedo range, is the superior of the battleship, since the battleship is vulnerable to the torpedo—the weapon of the submarine. In the ability of the submarine to submerge itself to considerable depth and thus secure the protection of an incompressible liquid medium, the craft possesses the power to assume an indefinite thickness of armor. This, combined with its invisibility, makes the submarine doubly secure from the gun—the weapon of the battleship.

The first qualities demanded of the submarine are naturally those of ready submergence and ability to maneuver at will while submerged. Indeed, in most types of the past, this, except for ability to place or discharge a torpedo, was the only accomplishment hoped for; speed, seaworthiness and cruising ability being considered as foreign

The Inside of a Submarine



Inboard Profile

A. A. Bronze Conning Tower
B. Sighting Hood
C. C. Hatches
D. Exhaust from Engines
E. E. Torbedo Tubes
F. F. Gasoline Tanks
G. G. Line of Spindle Hull
H. Galley Compartment
I. I. Crew Space
J. Air Lock
K. Diving Compartment
L. Diving Door
M. M. Storage Batteries
N. N. Drop Keel
O, O. Wheels
P. P. Anchor Weights
Q. Q. Ballast Tanks
R. Horizontal Rudder

R. G. Skerrett, copyright, 1903

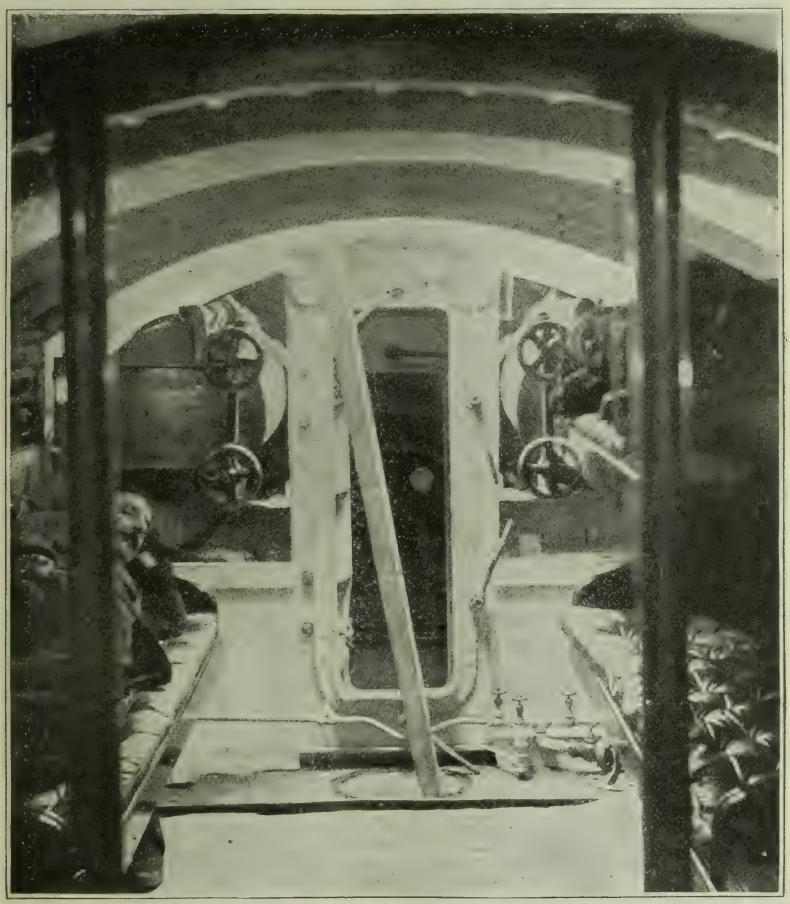
to the type. Heretofore it has been generaly accepted that the submarine, like the devil fish, must to a great extent lie in wait for its prey. It has thus beer granted the security of a harbor for base of operation, and its field of usefulness has been narrowed to the defense of that particular port. Changes of base as well as cruises to distant points, heretofore, have generally been made from the end of a towline.

The combination of facility of submergence with comparatively great longitudinal stability secured in the Protector, is the most remarkable feature of this interesting boat.

Since the Protector was launched she has been in active commission under command of her designer, with a crew of seven skilled men and a steward. Since July 9, 1903, the writer has been on board during all runs and submergencies. Submerged runs have been made at depths of 48 feet in depths of water to 16 fathoms. In a rough sea there is some difficulty in handling the boat for submerging, due to fluctuations of water level in the buoyancy gauge, but once submerged there is no difficulty in handling her under the conditions thus far experienced.

The Protector has an installation of gasoline engines which can be used while the boat is partly submerged. When entirely submerged electric motors are used for propulsion. The marked simplicity of gasoline engines for such propulsive work, since such installation obviates the use of steam boilers and condensers, leads to the possible conclusion that the day may not be far distant when we may possess submarine cruisers, with an endurance of machinery afloat that is not possessed by the present high-speed surface torpedo boats.

While cruising the crews have always



R. G. Skerrett, copyright, 1903

Living Quarters--Looking Forward

eaten and slept on board, the meals being cooked without difficulty on electric stoves. In all respects, save that of deck room, and under all conditions of weather, this boat provides greater comfort for the crew than

structure. The superstructure is carried up from the greatest diameter of the spindle hull in a vertical direction. Midway in the length is a watertight transverse bulkhead, which divides the superstructure into two

R. G. Skerrett, copyright, 1903

Living Quarters--Looking Aft

the surface torpedo boats on which the writer has served.

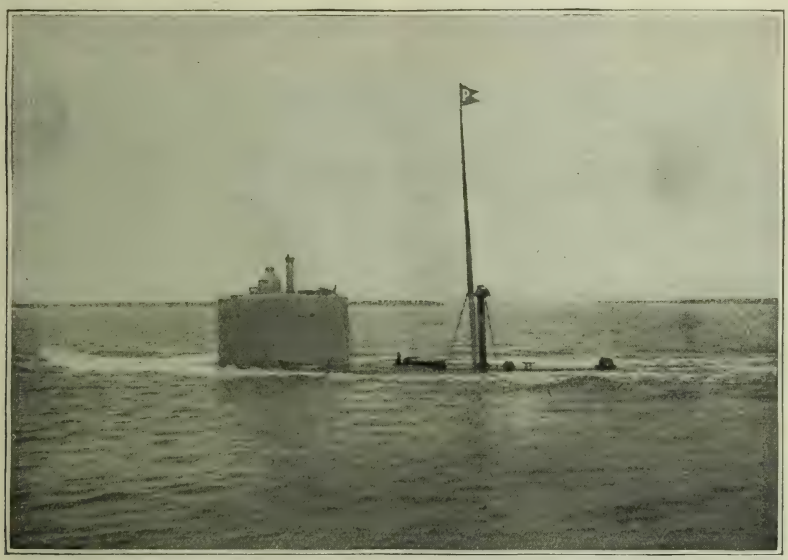
The Protector consists of a heavy spindle hull of mild steel, 65 feet long and with a maximum diameter of 11 feet 2 inches, with conning towers, designed to withstand an external pressure corresponding to a depth of 150 feet, and carrying a light super-

ballast tanks fitted with suitable admission and discharge valves. Access to within the superstructure is afforded through fourteen eliptical manholes, 16 by 12 inches.

In the superstructure are carried eight galvanized steel gasoline tanks with a combined capacity of 1,050 gallons; two lubricating oil tanks, holding 120 gallons; six

high-pressure air tanks with a combined capacity of 21 cubic feet and four low-pressure air tanks with a combined capacity of 12½ cubic feet.

Ventilating trunks, consisting of cylindrical bronze castings, 6 inches in diameter, worked watertight through spindle, hull and superstructure deck, carry miter valves operated by hand wheels from within the spindle hull. Watertight bronze caps cover the valves when cowls are unshipped. The spindle hull is lighted through deadlights, in trunks, worked through superstructure and provided with clapper valves serving as battle ports. At a depth of 40 feet it has been found that the hull is reasonably well lighted, it being possible at this depth to read a newspaper under the deadlights without the aid of artificial light.



R. G. Skerrett, copyright, 1903

Degree of Submergence--Structure Awash

The Protector is intended to carry 3.55 M. Mark III Whitehead torpedoes, three in the tubes and, if desirable, two spare ones under the berths in the crew space. The boat's stability when submerged, both longitudinal and transverse, is such that the torpedoes may be loaded without materially affecting the trim of the boat or the control of depth of submergence.

The forward diving compartment is, perhaps, the most spectacular feature of the boat. It is separated from the crew space by the air tight bulkhead and by an air lock 42 inches long built into this bulkhead, and fitted with air and watertight doors—the whole being designed to stand a pressure of 75 pounds to the square inch. The diving compartment is fitted with a connection to the low pressure air system, a telephone and a gauge with two hands, one of which registers the pressure due to the depth of water and the other the air pressure within the compartment. In the bottom of the compartment, forming a portion of the hull, is a cast iron door, stiffened with transverse ribs, which, when the door is opened, serve as steps. To open the diving door when resting or running along the bottom, the air lock doors are closed, a valve on the air connection is opened, and the pressure in the compartment allowed to increase gradually until the two hands on the gauge balance. A try cock in the door is then opened and the balance of the pressure verified. The door is then undogged and allowed to swing open, giving, in clear water, a good view of the bottom. A diving suit fitted with telephone connection is provided, the air hose being connected with a low-pressure air-tank in the compartment, the pressure being controlled by the diver through a valve in his helmet. Thus persons in the diving compartment are in telephonic communication with the diver and the rest of the boat.

The diving compartment provides for: Cable cutting; destruction of mines; means of escape for the crew in case of total disablement of the boat, and means of communication with shore by cable when on

picket duty. In demonstration of these features the diving door has been opened five times in the writer's presence in depths up to 32 feet. A member of the crew in a diving suit and one in a bathing suit have been sent out. the latter to demonstrate the method of escape.

Two hollow cast iron wheels, 34 inches in diameter and with 10-inch rims are hung by forged steel jaws, pivoted through the cheeks of the keel and connected with hydraulic operating cylinders. The wheels house in pockets in the hull. The pressure in the hydraulic cylinders by which the wheels are raised and lowered, is obtained from a hand pump forward in the crew space. This installation is designed to permit the utilization of the bottom as a guiding medium. The conformation of the Atlantic coast is in many localities such as to permit a submarine to run along the bottom well beyond blockading range without reaching her limit of depth, which in the case of Protector is 150 feet. In a boat running thus, control of depth of submergence is unnecessary and, being free from the influence of currents, a much straighter course can be steered than when running between the surface and bottom.

The cushioning of the hydraulic cylinders enables the boat to take the ground without injuring the hull. In submerged runs the Protector has frequently been allowed to take the bottom. This has always been accomplished without a jar or shock. It also permits the boat to rest on the ground in a ground swell as in the weathering of a storm. The wheels are in the nature of rollers, propulsion being as in other stages of submergence. While running in this condition if an observation is desired, the boat is brought to the surface by the hydroplanes.

The conning tower carries a sighting hood, omniscope, hatch and suitable lenses affording an all around view of the horizon. Within is most of the controlling mechanism of the boat.

The boat is equipped with two four-cylinder gas engines, each of 120-horse power. The cylinders are of 10-inch diameter, with a stroke of twelve inches, and, with the bases, are water-jacketed.

R. G. Skerrett, copyright, 1905

Degree of Submergence--Omniscope and Conning-Tower Hood

Ignition of the combustible is effected by a primary dry-cell battery, a magneto and a current from the storage batteries, with which combination no trouble due to lack of current has been experienced.

There is a six-pole shunt-wound Diehl motor in each main shaft line, the armature shaft of which is connected to the engine-crank shaft and to tail shaft by clutches. Each machine has a capacity of 37½ kilowatts at 125 volts when driven at 300 revolutions per minutes—a range of from 80 to 160 volts and a current capacity of 300 amperes at full load, with a momentary capacity of 450 amperes. Anchor hoist motors are located in the after end of the crew space on each side.

The storage battery compartment is mainly under the crew space. There are 60 Gould cells with spun plates of the Plante type. The battery can be discharged at a rate well beyond the capacity of the motors without injury to the plates.

The propellers are four-bladed, 45½ inches in diameter, with iron blades cast with a 3-foot pitch. The developed area of each propeller is 6.8 square feet.

The air compressor is located abaft the port engine and is designed to compress 60 cubic feet of free air per minute.

The pumps can be driven either by motors or engines and are noteworthy for their compactness.

The crew space is finished in mahogany and contains eight berths and pantasote cushions. The lower berths are in the nature of transoms, for which the upper ones, when lowered, form backs. Above and behind the berths are lockers. A folding table is provided, the lower berths serving as seats. There are two electric heaters in this compartment. Adjoining the crew space is the gallery compartment with electric stoves and washroom. A toilet room is located in the after engine room. An incandescent lighting system extends throughout the boat, there being 26 sockets.

In light condition the Protector, using engines and motors, has made a speed of 9.47 knots per hour; completely submerged, using motors alone, her speed is between 6 and 7 knots; partly submerged with engines and motors, 8 knots.

The most remarkable feature of the performance of the Protector is the facility with which her depth of submergence is controlled. Transition from one to another of the submerged conditions is almost at will being well within the time required for an intelligent observation through the omniscope. This is of primary importance, inasmuch as when within sight of an enemy it is intended to run completely submerged, except for occasional verifications of bearings and range through the omniscope.

When completely submerged and when submerged so that nothing but the top of the omniscope is showing, propulsion is by the motors alone. It is intended in the near future to make improvements so that air for induction may be taken through the top of the omniscope, so that the engines may be used almost to the exclusion of the motors. The elements most liable to disability in the submarine of today are the storage battery and the electrical equipment. Could the electrical equipment of the submarine be removed in its entirety the ability of the type to keep the sea without necessity of repairs would be increased three or four-fold, for it is only in this feature that the submarine is inherently short lived.

The efficiency and safety of the Protector under submerged conditions may be evidenced by the fact that no great degree of

R. G. Skerrett, copyright, 1903

Degree of Submergence--Signal Mast Alone Visible

skill is required in maintaining a uniform depth, since the writer on his first submergence was allowed to operate the hydroplanes for five minutes and succeeded in maintaining a depth of between 25 and 27 feet. The control of depth, while more delicate in the higher submerged speeds, may be maintained at almost any speed.

The omniscope consists of a 6-inch rolled brass tube, led up from a convenient level in the conning tower to a height when housed of eight inches above the top of the sighting hood. It carries five upper prisms with lenses. Four of these, used as finders, look ahead, astern and on each beam, each covering a field of 21 degrees, through a reduction in size of image. The fifth lense looks ahead and covers a field of 3 degrees 40 minutes, and presents the image in its true size without distortion. The commanding officer of a submarine must, in the absence of other means of range finding, be able to observe his target in its true size.

The omniscope is capable of rotating in azimuth to cover the entire horizon and can be raised two feet. It works through a stuffing box packed with leather, and is given a 12-inch bearing to take the thrust while submerged. On the lens of the direct-vision prism are two horizontal hair lines in the nature of a range finder. They are spaced to represent the height of a man at 300 yards, it being thought that in making an attack a man will generally be visible on the deck of the enemy.

The Protector has demonstrated the possibility of submerging with facility and at will without dangerous destruction of longitudinal stability, and the ability of a submarine to combine seaworthiness and habitability to such a degree as to enable her to keep the sea for long periods unattended. A study of the boat suggests:

1. That the logical development of the type will be a submersible cruiser of greater size and cruising radius with a surface speed sufficient to enable her to run down her prey and to cruise with a battle squadron.

2. That if the development of the storage battery is not such as to greatly decrease the weight per unit of horsepower and its liability to derangements, the electrical installation of the future in submarine vessels will be proportionately much less extensive than at present.

In this description, possibilities of the boat have been underestimated rather than overestimated.

R. G. Skerrett, copyright, 1903

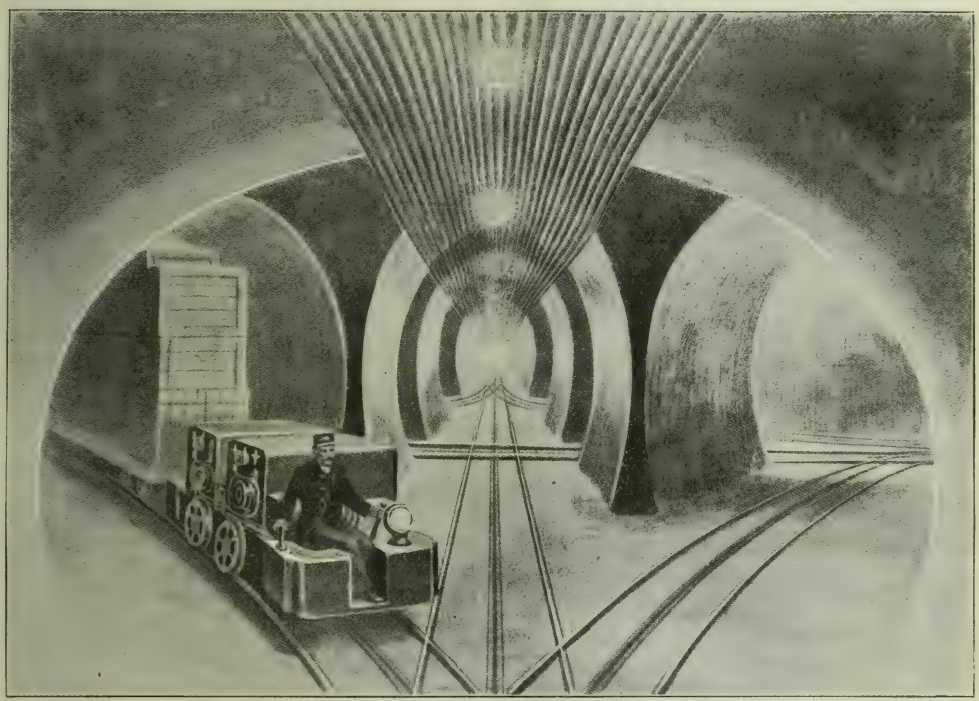
Degree of Submergence--Omniscope Awash

Did you ever notice the kind of people who write for Popular Mechanics? They are always people who know what they are talking about. Marconi writes about wireless telegraphy. Thomas A. Edison writes about electrical inventions and discoveries. M. Curie, the discoverer of radium, writes about radium. Sir Thomas Lipton writes about yachting. Santos Dumont tells about flying machines. Army experts describe submarines and shipbuilding devices. United States Consul-General Mason tells of Germany's mechanical progress. The list might be lengthened almost indefinitely. Those who know most about it are the ones we get to tell about it. This is true of all Popular Mechanics articles whether or not the author's name is mentioned.

Great Freight Railway Underneath Chicago

Most Remarkable Installation in the World to Relieve the Congestion of Streets and Terminals

Forty feet underneath the city of Chicago is being built a freight railway system, which, primarily, will handle 50,000 tons of freight daily and ultimately 300,000 tons daily. The system at first will be 20 miles in length and will honeycomb the principal business streets, connecting all the depots, five stories high. Forty feet underground the freight cars will travel; immediately above these, underground cars will carry passengers to and fro; the surface cars will perform their usual duties on the street level; the river above the tunnels and below the car bridges will have its accustomed

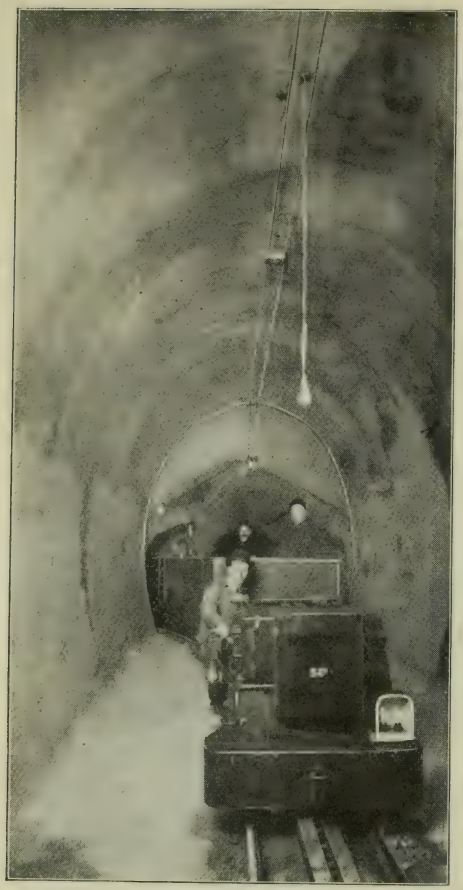


Electric Engine Hauling Freight Train Underneath Chicago

freight houses, hotels, office buildings and business houses. The freight cars will run into the basements of the big buidings, each basement being a miniature freight depot provided with switches and other facilities for loading and unloading freight.

The freight railroad is being laid in the great system of tunnels underneath Chicago's streets which was described and illustrated in a previous issue. It is now proposed that another tunnel be dug above this tunnel for the construction of underground passenger railways to relieve the streets of the congestion of passenger traffic. Thus if this latter scheme is carried out Chicago will have avenues of traffic from three to amount of boat traffic and above the river the cars will speed along the elevated roads. Probably the next step will be to build a two-story elevated road with cars running above those on the present elevated system and six stories above the freight line, which is two stories underground.

The Chicago underground freight railway will be unlike anything ever before attempted by any city. Its object is to expedite the delivery of freight, to aid the cramped railway terminal facilities and to relieve the congestion of teaming on the streets which is rapidly growing intolerable. Seven million dollars have already been spent in constructing the tunnel. It has



Underneath Madison St.

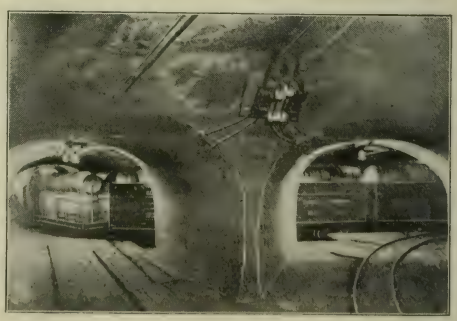
been an easy matter to obtain all the cash required for the construction work and for the successful floatation by the Illinois Tunnel Company of a $60,000,000 corporation, half in stock and half in bonds.

The work of building the railroad is progressing rapidly. Already three miles have been constructed, and two electric locomotives and 24 steel cars are in operation. The Illinois Tunnel Company, the owner of the project, has let the contract for 3,000 steel cars and 100 electric locomotives, to be in operation June 1st. The freight cars will be employed in hauling every kind of freight, including coal and all kinds of merchandise. The electric locomotives will have a capacity of 250 tons each on the level and of 100 tons on the inclines which are to be used in connecting the railroad yards and buildings with the tunnel. The cars will each hold 25 barrels of sugar, flour or general merchandise or seven tons of coal.

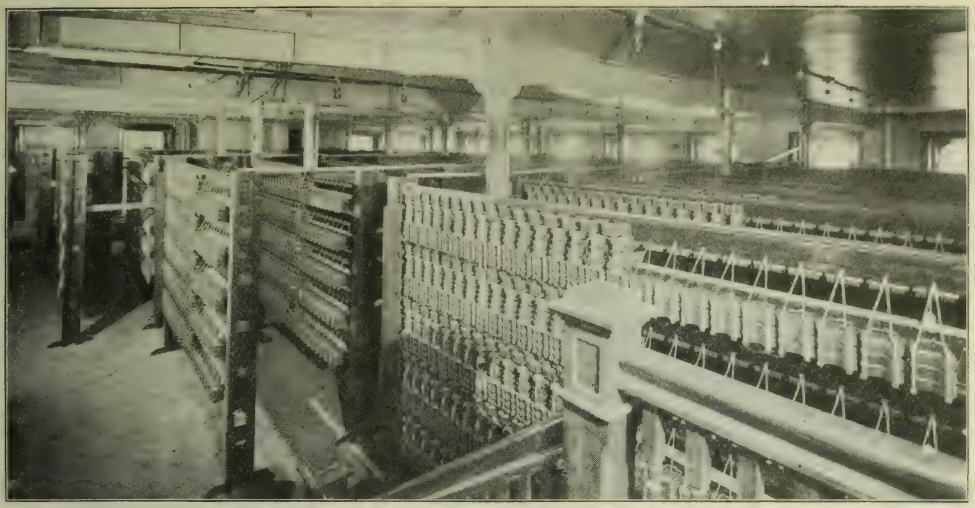
One of the most valued services of the underground freight railway will be in relieving the cramped condition of the Chicago railway terminals. It seems that the railroads exercised very little foresight in their construction when they built them. Forty per cent of the total railway mileage of the United States has terminals in downtown Chicago. Thirty-eight great railroads and railroad systems have their terminals there and these 38 are compelled to receive and deliver their freight from a mere half dozen freight depots.

At present more than $50,000,000 is spent yearly for trucking freight across the city from freight terminals to warehouses and stores. The cost to merchants averages about 90 cents per ton. With present facilities it is about the limit of capacity for a team to haul two truck loads of freight on a business day from any one of these depots. Under the tunnel system many times as much freight can be delivered and at a smaller cost for truckage. The underground freight system means certainty of delivery regardless of weather, the elimination of the coal heaver, and the doing away with the extra handling of dirt and other disadvantages connected with the present system.

Once in full operation the tunnel freight system means the removal from the streets of a vast amount of the teaming and trucking now done. It is estimated, however, that the increase in business in the next ten years will cause the tunnels to be doing as much as the teams now do and the teams to be hauling not a ton less traffic than at present. In the same tunnels where the freight cars will run telephone wires are be-



Showing Net Work of Tracks in Sub Service Freight Railway



Largest Switchboard in the World Built for the New Chicago Telephone Service, the Wires of Which are Strung in the Freight Railway Tunnels

ing strung for the new automatic telephone installation, an electric parcel delivery will be in operation and tubes will be extended for the tube system of mail delivery between the main post office, substations and depots.

On the night of February 10 the enterprise was inaugurated with an underground banquet to the Chicago Press Club and its friends, 1,200 in number. A continuous table over 1,000 feet long was set in one of the tunnels.

Tropical Hat Makers Getting Busy

Cuba and Porto Rica Anticipate Another Season of Panamas

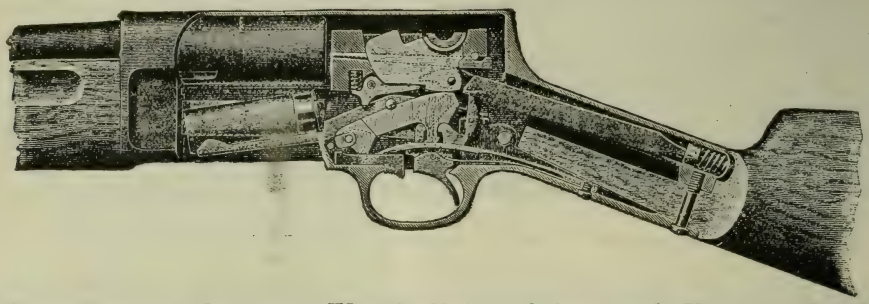
Anticipating a continuance of the popularity enjoyed by the Panama hat in the United States of recent years, the approach of spring finds the hat makers of the tropics busy weaving the straws into shapely tiles. The accompanying illustration is from a photograph sent to Popular Mechanics from San Juan and shows a typical Porto Rican hat factory. It is very much like the picture of a Cuban hat factory illustrated in a previous issue.

The Cuban and Porto Rican Panama hats, of course, are not genuine Panamas, but are slightly inferior in quality to those made in Central and South America, which are woven under water. They are handsome in appearance and will last nearly as long as the more costly Panamas. Nearly every rural resident of Cuba and Porto Rica is a hat maker and half the homes are miniature hat factories. The making of the hats is a favorite occupation of women and children.

An Era of New and Powerful Fire Arms

Types Completely Revolutionized by New Inventions--How An Inventor's Persistence Won Him Fortune

A new age of firearms is upon us. Late inventions have completely revolutionized the style and efficiency of revolvers and shotguns. The double-barreled hammerless breech-loading shotgun, until recently considered a model of proficiency will in a short time appear as antiquated as the old time muzzle-loader, and if improvements continue as rapidly as at present, before long, it will be regarded as a curious relic even as the ancient blunderbuss is now regarded.



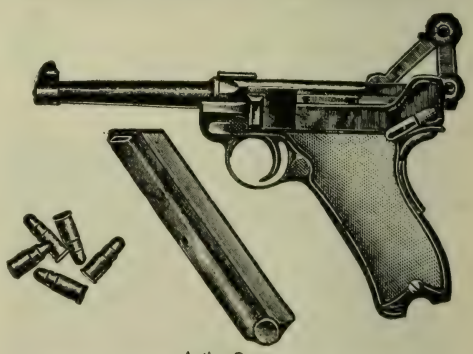
New Five-Shooter Shotgun--The Delight of the Duck Hunter--Sectional View

Following close after the invention of the automatic magazine "gun," described and illustrated in the January issue of Popular Mechanics, comes the automatic shotgun, destined to become the delight of the duck hunter and in all respects the most wonderful sporting arm of the age. Differing so radically in appearance and mechanism from the usual type of shotgun and possessing such phenomenal efficiency it foretells that its present odd appearance will soon become familiar to all hunters and the now common breech-loader will early become the gun to be regarded as an oddity.

Simultaneously with this shotgun has appeared a new automatic pistol, decidedly unlike the magazine gun previously described, but equally powerful. Its design and mechanism are as different from the present type of revolver as are those of the magazine shotgun from the ordinary breech-loader. Each of them looks so different from the familiar types that at first glance the uninured would scarcely recognize it as a firearm.

A very remarkable invention is this new automatic pistol. Because of its great superiority over all others, it has been adopted by the board of ordnance and fortifications of the United States army. This pistol will kill a man a mile away. It has a muzzle velocity of 1,150 feet and a range of 2,000 yards. It shoots eight shots in quicker succession than any other known hand arm, and in accuracy of aim and terrific force it is equal to most modern rifles. Its magazine contains eight cartridges and is held in the stock of the pistol. When empty the magazine can be thrown out and replaced in a moment—quicker than a single cartridge could be placed in a revolver. The pistol is of foreign manufacture and is known as the "Luger," but it shoots cartridges manufactured in this country.

The weapon shown in the illustration is



Action Open.

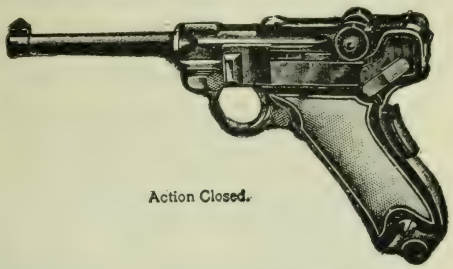
Pistol that Will Kill at a Mile

7.65 M. M. caliber, center fire, blued finish, walnut scored stock. The barrel is 4½ inches long and the entire length is 9 inches. It weighs 29 ounces. Its perfect balance and simplicity of action are among

its most commendable features. The pistol operates on the link system. The recoil caused by the discharge of the cartridge forces the barrel and breech stock backward, extracting and ejecting the empty shell. The magazine spring then brings a new cartridge up into place to be forced into the breech automatically by the return of the breech block and the pistol is again loaded and ready to be discharged. The cartridges are made in either soft point or steel jacket bullets. In the recent government tests at Springfield armory, 116 shots were fired with this pistol in one minute and a score of 24 bull's-eyes out of 30 shots was made by one man firing rapidly.

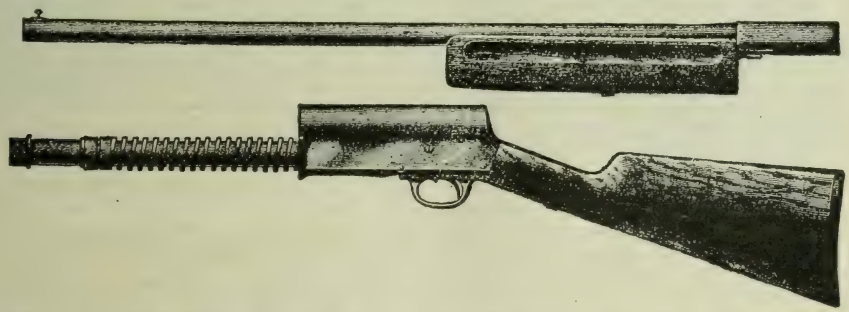
THE NEW AUTOMATIC SHOTGUN.

Shooting five shots consecutively as rapidly as the trigger can be pulled, doing away with the recoil that causes the ordinary shotgun to "kick," and being powerful in its force and remarkably accurate in its aim, the automatic shotgun possesses such great advantages over the old types as to scarcely admit of comparison. In effect it is a single-trigger five-barrel gun, with but one barrel to aim, carry and clean. Two shots can be fired from it far more rapidly than from a double trigger double-barrel gun, or as rapidly as from a single trigger double gun and with much greater precision; and then three shots are left empty shell, inserting a cartridge, cocking the hammer and closing and locking the breech are performed by the recoil, leaving the arm ready to be fired again by a pressure on the trigger. In consequence of its being utilized to operate the mechanism, the recoil, which in other guns is worse than wasted on the shoulder, is largely absorbed and the shooter is spared the discomforts that otherwise result from the "kick." Also this reduced recoil does not throw the



Action Closed.

shooter out of position and consequently he can place the following shot with greater rapidity and accuracy. A woman can use this gun not only with comfort but with pleasure and it will be found a delight to all those affected with shooter's headache. The popularity for this gun has been so phenomenal that the manufacturers have been unable to supply the demand and the supply is at present exhausted.



Showing Stock and Barrel of the Automatic Shotgun Disconnected

which can be fired with equal rapidity and accuracy. The only limit of speed is the rapidity with which the shooter can pull the trigger. After the five shots are exhausted the magazine can be loaded with five more nearly as quick as a double-barrel breech-loading gun can be loaded.

The automatic gun is hammerless, with automatic ejector, single trigger, repeater, and greatly reduced recoil. It is entirely automatic in its action, excepting only that the trigger has to be pulled for each shot. All the actions—opening the breech, ejecting the

There is an interesting story of genius unrecognized in connection with the invention of the automatic shotgun. Its inventor, a youth living in Ogden, Utah, spent many years in thinking out the plans and operations of the parts. He virtually had it perfected years ago, before the automatic pistol was thought of. Believing he had a wonderful contrivance he had it patented and then set himself to work trying to get it manufactured. Being without means himself his only hope was to interest some financier or manufacturer. He laid the

plans before wealthy men of his own town, all of whom dismissed his plea with few words, saying that the weapon was impracticable. Still confident of the worthiness of his invention he left his home town and visited Chicago, where the model of the gun was exhibited to wealthy manufacturers and earnest endeavors made to interest them. In nearly all instances he was turned away without even being given an audience. Then to New York he went, with no better success, always being dismissed as a visionary inventor. The youth returned to his home in Utah, his small savings wasted in paying railroad fare, greatly disheartened but not discouraged. Like Christopher Columbus, when his own people would not listen to him, he sought foreign fields. He began to write letters to European manufacturers. In the town of Liege, Belgium, he found a manufacturer who readily recognized the merits of the shotgun and at once undertook its manufacture, agreeing to pay the inventor a liberal royalty. This manufacturer hurriedly placed the guns on the market in the United States, as well as in the countries of Europe. Its success was instantaneous. The sales in the United States far surpassed those of any other nation and the manufacturer is so elated that he has decided to build a plant in this country exclusively for the gun's manufacture. At present none of the guns can be bought. They have been sold as fast as they reached America, and the manufacturers cannot keep pace with the orders. The Chicago agency from one of the guns placed on exhibition now has 300 orders and not a single gun in stock. The inventor is in a fair way to become a millionaire.

Lipton Scores American Yachting Rules

Make Competitors' Success Impossible--Advocates King Edward's Cup Race

By Sir Thomas Lipton

So far as the American cup is concerned I do not see how any fresh challenge can be forthcoming under the present conditions of measurement. I do not mean for a moment to suggest that I have a monopoly of challenging or that I am the only man likely to do so.

But the present rule is proved obsolete. It is 50 years old and under modern conditions it makes the success of a challenger almost impossible. It is time that such go-ahead people as the Americans abandoned this out-of-date rule and framed a rational one suited to the present conditions of racing.

The recent races have shown that it is beyond the wit of even the cleverest designers to build a yacht capable of crossing the Atlantic without injury and then compete with a home-made boat in whose construction the ocean-going strain does not have to be taken into account and provided for. Why, if the last defender of the America cup had had to cross the ocean she would have gone to pieces. She could not do it. It must not be imagined that I am grumbling in the least at my luck. I never grumble. But I merely wish to impress so strongly as I possibly can on the minds of American yachtsmen that in my opinion no yachtsman can challenge from this side with the least hope of success. Experience, not merely mine, but that of my predecessor, has demonstrated this.

The remedy I suggest is very simple. But it must be borne in mind that the rules of measurement for international cup racers are not now applied to any other yacht races in America. New rules were adopted last year by the New York Yacht Club for its own contests, and if these were applied to the international cup races it would enormously facilitate matters for the challenger and competing yachts could then race under absolutely identical conditions. But as long as the old rule remains in force the results in the future will be the same as in the past.

As to the ocean race for the Kaiser's cup, that is in abeyance, so there is no need for my expressing any opinion about it.

Beyond that, I see no reason why the Gibraltar to Nice race for King Edward's cup should not prove very successful and the competition be fair to all concerned, as all the yachts meet on equal terms.

For myself, I really do not know whether I will challenge again for the America cup.

Commentaries on the Far Eastern War

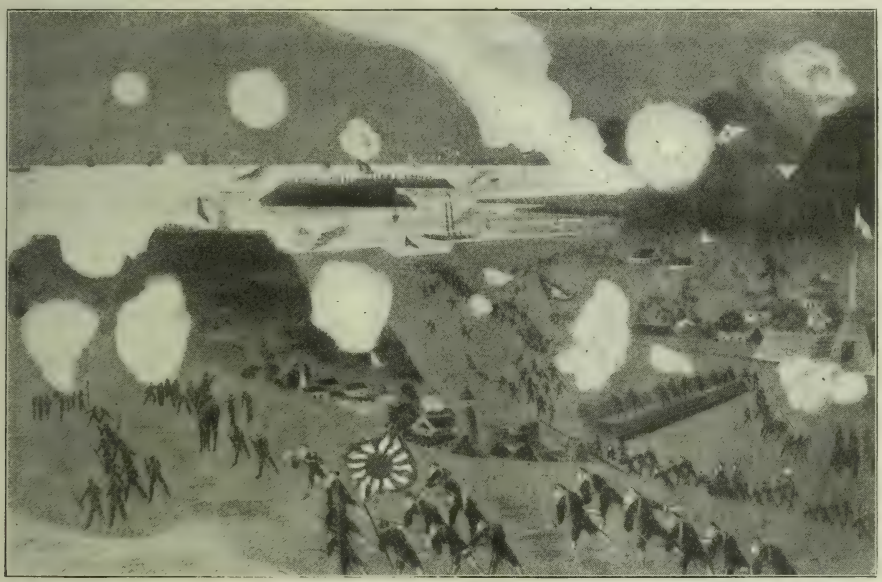
How Japan Worked While Russia Prayed -- A War of Mechanics--Coaling at Nagasaki--Perils of the Battleship Stoker

By Paul Arr

"But it is not believed that the Czar's desire for peace, nor the intercession of nations, can long avert the threatened war. Diplomats agree that it is an unavoidable event in the game of nations. Japan is only one of the chessmen that the British empire is moving to checkmate the great and accumulating power to the north and east and nearly everywhere—the Russias."—Extracted from Popular Mechanics, January issue.

And so the war, diplomatically regarded as inevitable, has come. It is a war in which mechanics will figure more than in any other conflict in history. In fact, its success depends not on the number of combatants of either side, but on the more powerful mechanical devices for inflicting destruction and death either can bring forth. Japan, having the more modern warships, submarines and shoulder arms, and a better knowledge of their use, has gained a big advantage in the start, but Russia has several powerful battleships now being built, and modern guns and other implements of war which are being put in service as rapidly as they can be obtained. Russia, in fact, was caught napping.

The Czar is at the head of the Greek church in Russia, and is very devout in his religion. Like his own Cossacks, who for more than a thousand years have made religion an excuse for war and pillage, the Czar makes use of public devotion to further the success of Russian arms. His first step after seeing war to be inevitable was to engage in lengthy religious services and to call on all his people to pray for the success of Russian forces. While Russia prayed, Japan, believing in Napoleon's maxim, that "God is on the side of the heaviest artillery," busied herself getting

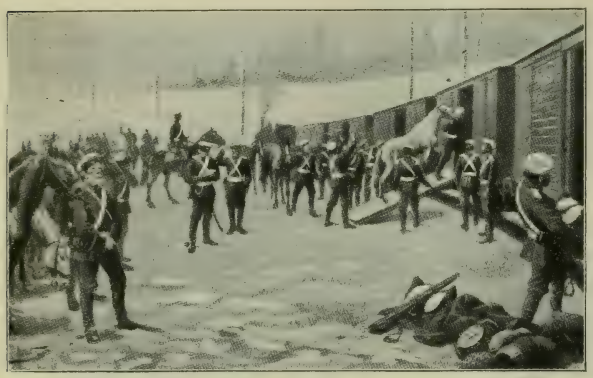


The Japanese Bombardment of Port Arthur--From a Sketch Made by a Japanese Artist

Korean Soldiers Marching Past the Palace Gate at Seoul

her ships and guns in shape and in striking wherever she saw an opening.

Christianity is the religion of Russia, and the principal churches are the Orthodox Greek or Russian and the Roman Catholic.



Entraining Russian Cavalry for the Far East on the Trans-Siberian Railroad

The cherished desire of the imperial policy, however, is for all the Russians to become amalgamated with the Russian church.

The Japanese are pagans, and deny the existence of a Christ. Their principal religion is Sintuism and Buddhism. In Sintuism they worship the sun goddess, of whom the mikado is supposed to be a direct descendant. No less than eight Buddhist sects exist in Japan, and images of Buddha are to be found in all sections.

But the Japanese do not put the faith in their idols that the Russians do in Christianity, and so have given but little time to religious preparation for the war. But Russia's movements are ever slow and determined, and it may be that her time to exult will come yet.

JAPANESE GUNNERS GOOD SHOTS.

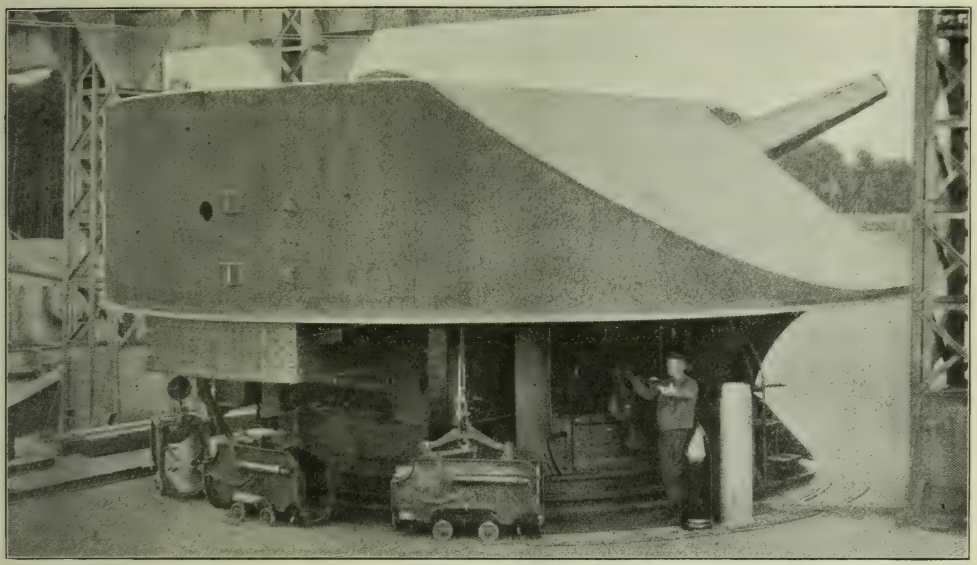
The Japanese gunners are said to be expert shots, quick in movement and accurate in aim. They have long been in training under the direction of some of the best artillery instructors in the world. A special feature has been made of light pieces for landing parties. One of these small guns is shown in the illustration. The gun itself weighs only 400 pounds, the carriage 700 pounds and the limber with 36 rounds 1,300 pounds. The piece throws a 12½ pound projectile 1,600 feet per second. The outfit can be taken almost anywhere and at close range can render good service.

The coast defenses of Japan are reported to be very complete, and well manned. Nature has furnished finer fortifications to this island than those possessed by any other nation in the world, and in many cases little work was necessary to make them strongly fortified. Some of these coast defenses are very heavy. In the illustration is shown one of the coast guns built by Krupp, and photographed at the works after erection for testing. It was then taken apart and shipped. This rotating turret houses a gun throwing a 981

A Japanese 3-Inch 12-Pounder Landing Equipment

Weight of Gun, 4 cwt. 14 lb.; ditto of Carriage, 7 cwt. 3 qr. lb.; ditto of Limber complete (with 36 rounds), 13 cwt. 6 lb.; Muzzle Velocity (foot seconds), 1,600; Weight of Projectile, 12½ lb. The Limber consists of a steel frame, supported on the axle by brackets and springs. At the rear of the frame is a hook for attaching the gun carriage when travelling, and the front is fitted to receive the pole, which is attached to the axle by means of a bolt.

pound projectile with an initial velocity of 3,038 feet per second. Electric or hydraulic power is used to rotate the turret, but in case of accident it can be turned by hand. The gun can also be loaded by hand power



A Krupp 12-Inch Gun in Rotating Turret Built for the Japanese Coast Defence Service

The projectiles weigh from 771 lbs. to 981 lbs., and their initial velocity attains 3,038 foot seconds. The maximum range at 22 deg. of elevation is 21,872 yards, and at 45 deg. of elevation 27,340 yards. The turret is rotated and the gun loaded by hand power, but either electric or hydraulic power can be applied, if desired.

should the other machinery become disabled. The small cars seen in the foreground are for hauling shells to be fired.

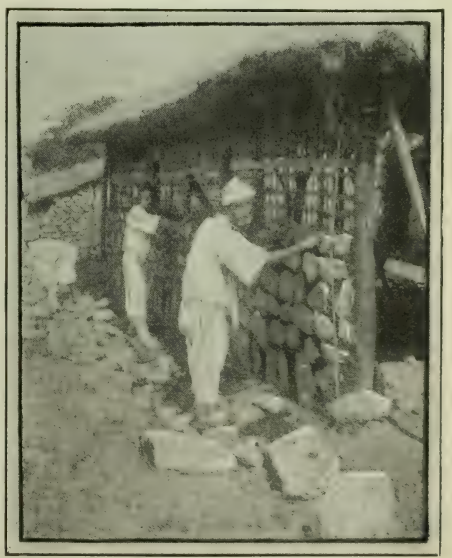
JAPAN'S PREPARATIONS.

Japan is certainly much better prepared than Russia. For months past her armories and naval stations have been beehives of intense energy. Russia, under the pretense of prolonged negotiations, sought to gain time and defer activities until the summer sun had unlocked Vladisvostock and made transportation across Siberia practical. The Czar personally, though a weak and vacillating person, wanted to avoid war, but his cabinet, army and naval officers did all in their power to force the issue.

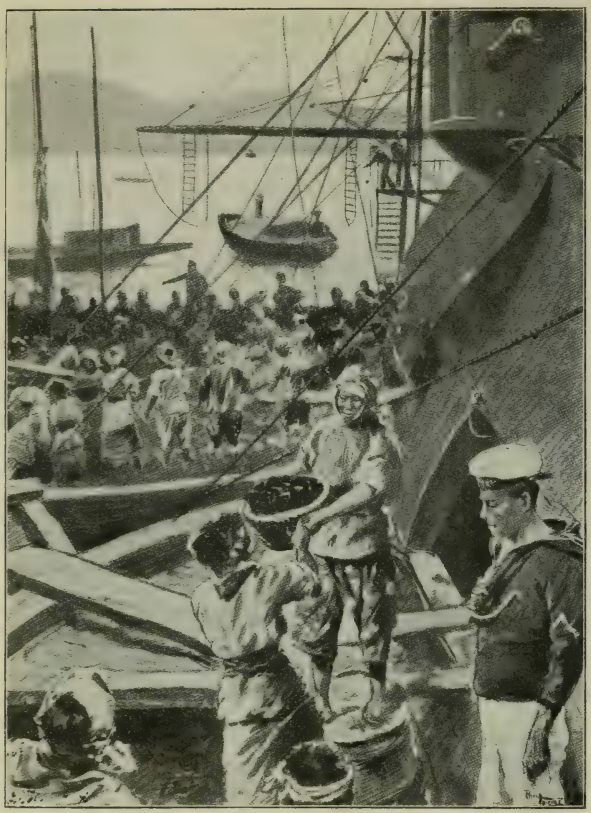
One of Russia's most serious obstacles in the war is scarcity of coal in the far East. Japan seized upon the time when Russia's coal bin was low to begin the war, and has succeeded in cutting off many sources of supply. Neutral nations cannot now permit Russia to coal at any of their ports, coal being contraband of war. Japan, on the other hand, is well supplied with coal. She has been storing up fuel for a couple of years.

HAS THE RECORD FOR FAST COALING.

Nagasaki, being in the heart of Japan's coal district, is the point where all the war vessels coal before starting on their journeys. Here is laid up a supply of coal



Building a House in Corea



Women Loading a Japanese Warship at Nagasaki

sufficient to last for years, and still strings of coal lighters may be seen daily going to and fro between this city and the coal mines on the neighboring islands. It is said that a vessel may be coaled quicker in Nagasaki than in any other port in the world, and here the loading is all done by hand.

Eliza Scidmore, the noted correspondent, writing from Nagasaki, says: "Coal is not put aboard as quickly in San Francisco, Tacoma, Seattle or Vancouver, with all the aid of overhead machinery and elevated tracks for coal cars, dumping directly to the ship's docks.

"All the mail steamers of the east, save the French Messageries Maritimes, coal at Nagasaki on outward and inward trips; all the naval ships fill their bunkers here, and once each month the American transports, home bound from Manila, stop to take on coal."

WOMEN, TOO, LOAD COAL.

Women, as many as men, engage in the work of coaling vessels at Nagasaki, and the celerity with which they work is a wonder to all who have ever witnessed them. The coaling is done by means of shallow baskets, which are filled in the lighters and passed rapidly from hand to hand until dumped into the bunker's mouths. The coal-passers are paid by the ton, and average about 30 cents a day, half price for women and children. During a deluge of rain these men, women and children put aboard a vessel 1,550 tons of coal in six hours. Frequently 1,210 tons have been put aboard ship in three and one-half hours. Recently 2,100 tons were put aboard in five and one-half hours, during which time each gang had a half-hour rest for their mid-day meal.

THE STOKER IN WAR.

The war vessel loaded, then comes the work of the stoker, who shovels coal into the fierce fires of the furnaces, twenty-five feet under the surface of the water, while the engineer officer below looks to steam and water gauges, to the precision of the stokers and the enginemen; and with them, unconscious of any peril that may threaten from the enemy, may rank in courage the admiral on the bridge. Recognizing the boiler rooms as the heart of the great war vessel of the modern navy, the boilers are placed in the center of the ship and surrounded by the coal bunkers. Overhead is a protected steel deck covering, and over this is a deck proper. As the armor of the ship dips only a short distance below the surface of the water, these decks are an especial protection to the boiler rooms and engine room. The bank of boilers may be twelve feet high, and the top line of this may be twelve or thirteen feet below the surface. Between these decks and the submerged armor there is protection against a direct shot, but to the stoker, far down in the blind boiler rooms, under thousands of tons of water, the armor-penetrating shell, fire, collision, submarine mines—all the dangers than menace the warship in an engagement are his, increased a hundred fold. His chance of escape in case of a sinking ship are one in a thousand. The glamour of the battle is not for him. The shout and huzzah of victory, or the grim, set face of one who sees his

defeat before the blow for him has struck—they are beyond him. He shovels coal and removes ashes, always with an eye to the steam gauges and the water gauges, and with an ear to the messages that may come from the bridge as to the progress of the fight—provided the commander has thought it necessary to report to the boiler rooms and engine rooms. And thus watching and listening, he shovels more coal and more ashes.

Cossacks, the Rough Riders of Russia, Guarding the Trans-Siberian Railroad in Manchura

BOILERS OF WAR VESSELS.

The water-tube boiler is almost universally used on big battleships. It is built in sections, consisting of tubes of comparatively small diameters, in which the water is held, the tubes lying horizontally in vertical, narrow piles, between which the flames and heat from the furnace fires pass directly, the result being that, whereas a Scotch marine boiler of a certain horsepower might require two hours in which to raise steam to a working pressure, the water-tube boiler would do the work in half an hour.

In the water-tube boiler, also, the fact that it is built in sections makes it possible, in case of damage to one of the units, to have the unit cut out of the service without making appreciable difference in steaming power—a great advantage in time of battle.

Japanese Infantry on the March--The Japanese soldier is small in stature, but very wiry. His resistance of fatigue is remarkable, although his food consists only of rice and fish. He is intelligent and well trained,

America's Debt to John Hay

By Thomas D. Knight

The world resounds with the clash of arms in the Orient. Every roar of the gun, every stroke of sabre, every explosion of the torpedo against the side of the battle ship, is swiftly, surely, making history for all the future.

Since the sixteenth century Russia has been pushing its borders ever eastward, until its standards, starting from the Baltic dip in the waters of the Pacific. With the silent persistency of the glacier she has ground her way. When obstacles arise she has been content to wait, but no backward step has she ever taken in all these centuries. Russia has two distinct objects, born of her necessities—an outlet on the Mediterranean and an outlet on the Pacific. These she must have, before she can achieve the mercantile and military greatness of which her statesmen have so long dreamed—and so she waged a successful war with Turkey, but at the moment when she saw fulfilled her first great object, the other European powers intervened, and the blue waters of the Mediterranean still lie beyond her grasp. She has reached the Pacific, but her harbors there are ice locked through the winter, and she has looked with covetous eyes at the populous lands and open harbor of the Chinese Empire to her south. For this reason Japan was not permitted to reap the fruits of her victory over China a few years ago.

Russia wanted them for herself.

The outcome of the boxer uprising demonstrated the utter helplessness of China to defend her possessions against any warlike nation, and Russia had decided the time had come to partition China. The great Siberian railroad was pushed to completion and began to pour into sparsely settled Manchuria a stream of soldiers and settlers.

During these centuries of Russian expansion, a new nation had been born across the sea; a nation as different in its laws and government from Russia as day from night, a nation "of the people, by the people and for the people." First a little fringe of colonists along the Atlantic, it grew by leaps and bounds, until its standards also dipped in the waters of the Pacific at its other side. It acquired by purchase Alaska; it took from Spain the Philippine Islands; it began the great work of building the Panama canal, at the probable cost of a quarter of a billion dollars. It did these things in the full expectation that its merchants, its manufacturers and its farmers would develop and participate in the market of the Orient.

Russia was willing that America should be well treated in the proposed partition of helpless China. France, Germany and even England were more than complaisant. It was a critical moment in the history of the world—should America sanction the spoliation and take its share. At this juncture it announced through its secretary of state, John Hay, that America stood for the integrity of the Chinese Empire and the "open door."

The saneness, the honesty, the fairness of this position was instantly seen and acquiesced in by every European government except Russia, who, pretending to acquiesce, still continued pouring her soldiers and settlers into Manchuria.

But the policy thus enunciated by Hay had won its way so completely into the consciences of men that no nation dared to stand longer with Russia for spoliation, and England and Japan placed themselves in line with America's policy. Russia promised to evacuate Manchuria; she fixed a day to do so, but still she stayed. Finally, the little brown men grew tired waiting, grew weary of promises broken, of excuses and subterfuges, and struck—struck for the "open door" and the integrity of the Chinese Empire, for the policy enunciated by America through John Hay.

Having enunciated this policy, and two nations having gone to war over it, it became of great moment, whatever the result of the struggle, that the policy itself should not be imperilled thereby. Again America, through John Hay, assumes the leadership, suggesting to the other powers that an identical note be sent to the combatants, insisting upon the integrity of China, the "open door," and that hostilities be restricted to the territory of the combatants, and the territory in dispute.

This opportune announcement has already received the approval of Germany in addition to England and Japan. Surely England, Germany, America and Japan, when united are strong enough to guarantee the fulfillment of this policy.

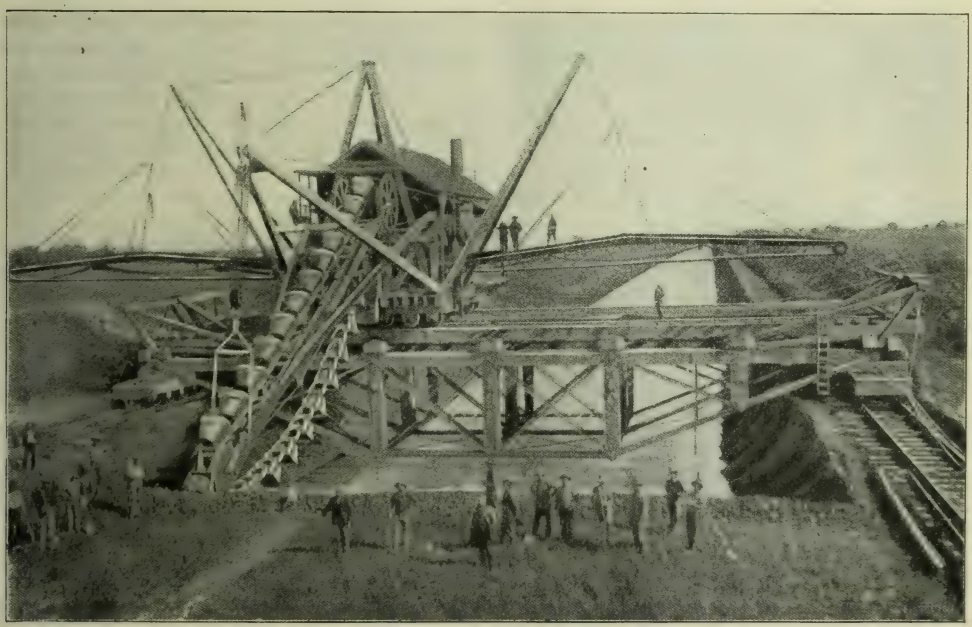
Thus has John Hay, quiet, unostentatious gentleman, secretary of state in two great administrations, been the instrument

through which America has been able to make certain that her work in the past shall not have been made nugatory by the greed of any nation or combination of nations; and that the markets of the Pacific shall remain open to all the world, so that her future teeming millions shall have the opportunity to participate therein.

Giant Excavator That Digs Canals

Does The Work of 1,000 Men Every Day

A thousand men toiling with shovels and wheelbarrows from sunrise to sunset could not accomplish as much work as the great steam excavator shown in the illustration performs in eight hours. The burning sun or rain in torrents has no terrors for this mammoth earth devouring monster. The scene is from a photograph of the construction work on the irrigation canal in Colusa county, California. The artificial river thus created is six miles long, 100 feet wide, and 35 feet to the top of its banks. The Sacramento river furnishes the water which makes fertile 156,000 acres of fruit ranches.



Excavating An Irrigation Canal

The excavator travels on its own railway tracks on each side of the canal, and as the work proceeds the track is taken up and relaid ahead of the machine.

The steel buckets which have sharp cutting edges move constantly by means of endless chains, and empty their load of earth first on one side then on the other. Wide endless belts carried on rollers carry the earth to the sides of the ditch.

All these movements of the machine are controlled by one leverman, who may be seen in the cut standing on the platform on the left of the bucket; he has control of five separate levers, one for raising and lowering the bucket chain, one for moving the car to the right, and another for moving the car to the left, and another for moving it forward on the side tracks, and the fifth controls the engine. The rapidity and facility with which all these movements are made is surprising, especially considering the momentum and immense weight of the car and bridge and the excavator's machinery, which is about 300 tons.

Lessons Taught by the Baltimore Fire

Danger of Frame Buildings and Overhead Wires--Necessity of High Pressure Water System

The Heart of Baltimore From a Photograph Taken After The Fire of February 7.--Courtesy the Chicago Chronicle

"America's buildings of all classes are the least substantial of those of any civilized country. Each class of buildings is improved after lessons similar to those of the Iroquois fire. The great Chicago fire of 1871 made Chicago's business houses more substantial. It will take time and hundreds of lives to give substance to our country's structures." —Extract from "Chicagoans Gave Their Lives for Our Protection," in the February issue of Popular Mechanics.

The Iroquois theater burned, killing 600 persons, and Chicago now has safe theaters. The city of Baltimore has burned and the Baltimore of the future will have safe buildings. All the theaters of America have been made safer as a result of the Iroquois fire. The burning of Baltimore will have a tendency to give better fire protection to all American cities. "It will take time" and lessons like these "to give substance to our country's structures."

Many lessons were taught by the Baltimore fire. It demonstrated that some of the supposedly fireproof steel skyscrapers were in reality combustible—another instance of terrible destruction resulting from over confidence of experts. Great office buildings alleged to have been proof against fire burned like paper and did nothing to check the flames.

The great lesson of the fire was the necessity of the high pressure water system, which with sprinkler attachments, furnishes a means of extinguishing a fire before it has a chance to attain dangerous proportions. This system, although expensive to install, would have saved Baltimore from destruction.

Another lesson taught was the great danger of overhead wires in cities. These so seriously hindered the work of the firemen in Baltimore as to permit the flames to attain such headway that it was impossible to check them. Baltimore was an old city, and the people disposed to adhere to time-honored ideals and customs. The buildings were generally firetraps. There were some steel structures but surrounded by frame shells, and throughout the city there were a great many wooden buildings and the buildings supposed to be of brick or stone were in many instances only pretenses with wooden frame and interior and brick and stone veneer. Such buildings are really more dangerous than all-wood structures and neither should be permitted in the business limits of a modern city.

Overhead wires have been cleared from the streets of many other cities, but in Baltimore a perfect network of them remained. No steps had been taken to remove any of them on account of the close connection between a political machine and the electricity producing and using corporation. The innumerable wires not only greatly hindered the firemen, but endangered their lives and also those of the spectators. Another serious hindrance in fighting the flames was the size of the Baltimore fire plugs. When the engines from other cities arrived they found their hose connections would not fit these plugs. This teaches the lesson that the fire plugs in all cities should be made adaptable to the engines of other cities which may be called upon in an emergency. This is a comparatively simple matter, but sometimes little, simple precautions prevent great disasters. Thus it is

seen that Baltimore's conditions seemed to work against the saving of the city and to the advantage of the flames. How many other cities are as poorly equipped?

The fire which destroyed 80 blocks of the city's heart and caused a loss of more than $100,000,000, was the first serious conflagration in which the skyscraper has played a part.

Men's efforts seemed powerless to check the progress of the flames. The very air seemed afire and as the parade of fiery tongues swept onward leaving devastation in their path, the fighters concentrated their efforts to confining the area of destruction to as narrow a district as possible. Great buildings were blown up with dynamite as a means of cutting off the flames, but they seemed to leap across the vacant space without hindrance and buildings were ignited blocks away. One by one these great buildings could be seen to reel and fall as the dynamite charges were exploded and then the fiery sea flowed over them without interruption.

The new Baltimore that is to arise from the flames is to be a model city. Its buildings will be fireproof and modern; all the wires will be run underground as they are in New York, Chicago, and all modern cities; the high-pressure water system will be installed, and the city will be laid out evenly and artistically. Baltimore has learned the lesson, but the cost was great.

Real Fireproof Skyscrapers Stood the Test

Great interest has been expressed as to the condition of modern steel skyscrapers in the Baltimore fire. The earlier newspaper reports had them all in ruins. The structures, however, seemed to have survived with serious damage to the interiors.

Mr. H. H. Glidden, manager of the Chicago Underwriters' Association, who made a personal examination of the ruins, says:

"All the steel structure of the fireproof buildings is standing intact with the exception of probably a beam or a girder here and there. The structure stands plumb with few exceptions and none of it is over an inch and a half out of line. As regards the covering of the steel work, it was found that brick survived the fire the best, and following that the best quality of tile. All stone work, the poorer tile, and granite have crumbled. Underwriters are viewing the Baltimore loss purely as the result of fire, as naturally there was but little water thrown. I would estimate the loss on fireproof structures at from 50 to 60 per cent."

Another report from a prominent manufacturer of fireproof building materials says:

"The first-class skyscraper, with skeleton steel frame, properly protected with fireproof material, is a structural success. The Baltimore fire has resulted in a victory for the modern type of fireproof building that had its origin in Chicago.

"Twelve of the skyscrapers are standing. They are as perpendicular as the day on which they were completed, though everything inflammable in them was burned—even to the nailing blocks. The stone and granite exteriors have been considerably damaged, but were not stripped off by the heat so as to expose the steel columns and cause them to warp and buckle.

"The Continental building suffered from the culminative force of the fire on four sides, yet it stands a triumph to the ingenuity of modern builders. The steel construction and fireproof material in the Calvert building is practically uninjured. In the Equitable building the only damage was to the steel arches, which instead of being protected with concrete were covered with wooden flooring.

"It was the hottest fire ever known. There must have been at least 2,800 degrees of temperature. Castiron mullions, typewriters, and plate glass were fused together. It was the same degree of heat as is found in a blast furnace.

"The fire has demonstrated that wood must not be used in a building intended to be fireproof. Highly finished woodwork is especially inflammable. For interior trimmings the only safe material is cement and imitation marble. All window frames and sashes should be made noncombustible."

What is to be the future of wireless telegraphy? What are the immediate improvements planned? Guglielmo Marconi, inventor of wireless telegraphy, will have something to say about this subject in next month's Popular Mechanics. You ought to read it and there will be many other enlightening articles in next month's Popular Mechanics, all written so you can understand them.

Great Interest in Motor Boat Racing

Racers With Automobile Engines Being Built and Preparations Made for a Lively Season.

From New York comes the information that the coming season is to develop unprecedented interest in motor boat racing. Prominent eastern yachtsmen are planning for contests and builders are busy constructing racers. More than one-half of the work now in the hands of builders is in launch or steam yacht hulls, with the type built for speed to be fitted with automobile engines, a new and important feature. The boom in the sport is due not a little to the formation of the American Power-Boat Association, and the method that organization has pursued in placing the sport on a sound basis. Rules of measurement and rating were adopted which brought order out of chaos. A trans-Atlantic steam yacht race has been suggested, but there are doubts that it will occur this year.

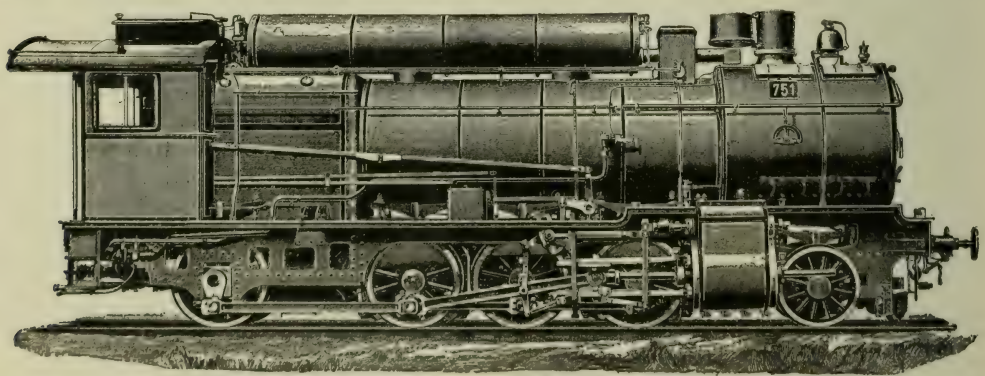
Prominent in the line of launch racing is the first competition for the $1,000 trophy offered by the American Power-Boat Association. This is to be a perpetual challenge cup, open to boats belonging to any recognized yacht club in the world, except that such club, if located in the United States, must be a member of the association. Boats must not be less than 25 feet water line and must rate not less than 35 feet, under the measurement rules of the association.

Great interest is being manifested in the match arranged for auto launches to take place under the rules of the American Power-Boat Association between March 15 and May 15. It is to be between the Vingt-et-Un and a craft to be built by C. H. Tangeman. The Ving-et-Un is a 30-foot speed launch of the extreme type, designed by C. H. Crane and built by "Tom" Fearon, once a noted oarsman and shellboat builder and a very clever workman. The motor is of the car type. It has four cylinders and is of 21 horse-power. The weight of hull and motor is only 770 pounds. In the trial trip the boat made a record of a mile in 2:36.

The race is to be for a stake of $1,000 a side for any distance from 20 to 40 miles on the Hudson or the Sound. The challenger will be powered with a motor of 24 horse-power. The boot will be 35 feet over all and will be designed and built by the Electric Launch Company of Bayonne, N. J.

FREIGHT LOCOMOTIVE FOR SAXONY.

Compared with the standard American locomotive, the type used in Saxony presents a strange contrast. The illustration



shows the style generally used in that country for hauling freight. These engines have eight driving wheels and are compound. A striking feature is the superheater for steam used in the low pressure cylinder. This heater is concealed from view, being located below the stack and using the otherwise waste heat. An increased efficiency of 10 to 20 per cent is claimed. The steam is reheated in the smoke box, while passing from the exhaust of the high pressure cylinder to the low pressure cylinder. The hinged smoke stack is for clearing low tunnels. The engines weigh 80 tons.

Lassa, The Forbidden City Entered

Remarkable Condition Discovered by a Daring Russian Who Disguised as a Priest Makes His Way Inside the Sacred Walls

The mysteries of Lassa, the forbidden city, have at last been explored. Disguised as a Buddhist pilgrim M. Ushi Narzounof, a Russian, entered the Tibetian city, took snapshots of the buildings and people and has given to the world a remarkable account of the strange and astonishing conditions existing within the walls that have excluded the emissaries of civilization for nearly a hundred years. These snapshots, some of which are herewith reproduced, are the first pictures of Lassa ever obtained. The daring Russian's success is especially interesting at this time owing to England's proposed invasion of Tibet, of which Lassa is the capital.

For centuries past nearly as many attempts have been made to reach Lassa as there have been to reach the North Pole, but none of them before have been entirely successful. True, several white men, through daring and ingenious strategy have made their way inside the walls, according to their claims, but fear of detection caused them to fly before the desired information was obtained. The Russian Narzounof seems to have explored the city at will; he gathered secrets regarding the affairs of government; took photographs of many scenes, even of the Lama's residence, and learned much of the strange manners and customs of the residents. He was a novice with the camera and consequently his pictures are crude, but being the only ones ever obtained of the most mysterious city on the globe, they are regarded as priceless.

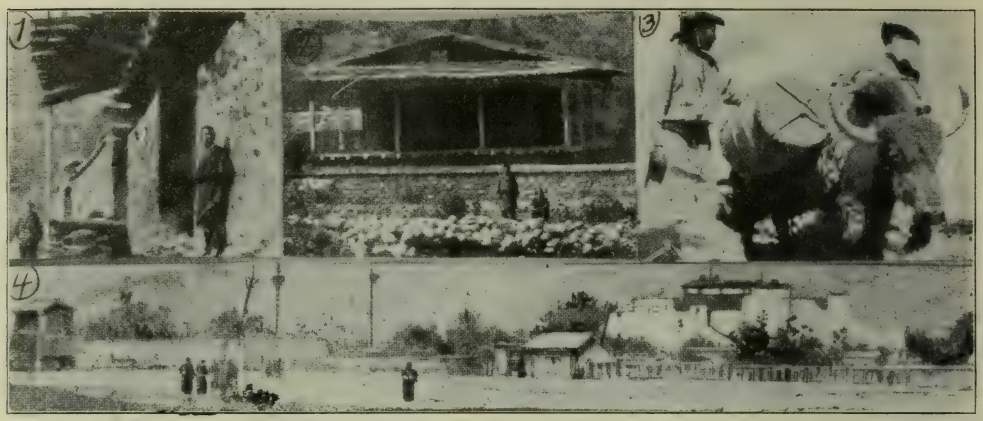
Lassa has been called the White City of Mysteries. It is to Buddhism what Rome is to Catholicism. It is the headquarters of the hierarchy of lamas, the Buddhist priests or monks. There dwells the dalai-lama, who up to the time of Narzounof's visit, was supposed to exercise priestly control over nearly all Mongolia as well as Tibet. Narzounof discovered that the delai-lama is merely a figure head, in truth a titled slave and that the Chinese viceroy is in reality king of Tibet and Mongolia. The city lies in a fertile plain, extending about 12 miles from north to south and about 125 miles in length. A Chinese garrison is quartered near Mount Botala, whose temples are resplendent with

M. Narzounof, the Russian who, Disguised as a Priest has Entered Lassa, the Forbidden City, and Given to the World the First Pictures Ever Obtained of that Strange and Unknown Municipality.

gold and precious stones. Since the expulsion of the monks of the Capuchin mission in 1792 no foreigners have been allowed entrance into Tibet from the south and none but pilgrims from the north.

Tibet is a great plateau in Central Asia. It is bounded on the north by Mongolia, on the east by China and on the south and west by Hindustan. The natives call it Bod or Bodyul, the land of Bod. It has an area of about 800,000 square miles, the northeastern part of which is yet entirely unknown to civilization. Its population probably amounts to 10,000,000. It has a mean elevation of nearly 16,000 feet above the sea level and has been called the "roof of the world." Its latitude is about the same as Egypt or Florida and it might be supposed to enjoy a tropical climate, but owing to its excessive

These Illustrations are From the First Photographs Ever Obtained of Lassa, the Forbidden City



1.—Street Scene in the District Inhabited by Lassa's Poor. 2.—A Typical Lassa Home. 3.—Method of Delivering Goods in Lassa. 4.—Palaces and Grounds of the Lamas

altitude its climate is as cold as the arctics.

The approach to Lassa from every side is guarded by almost insurmountable obstacles. Tibet itself is embraced by the Himalaya, the Kuen-lun and Altan-tagh mountain ranges. Besides these mountain ranges, the loftiest in the world, the northern and western frontiers are guarded by the Tarim and Gobi deserts. Such is the seemingly inapproachable region that the Buddhists centuries ago chose as their religious capitol. Five hundred million Buddhists are governed by the lamas, that receive their orders from the Lassa Holy of Holies.

Narzounof made the journey to Lassa in company with Mongul, Buriat and Kalmuk pilgrims, Russian subjects of the Buddhist belief. They make yearly journeys to Lassa for which facilities are accorded them by the Czar. Narzounof successfully carried out his guise as a priest and was never detected during the entire pilgrimage to and from Lassa. At the time of his visit the pilgrims in Lassa numbered 10,000.

Tibetian Method of Accustoming Souls to the Demons of the Lamas

Narzounof found the mechanical appliances employed at Lassa of exceedingly crude construction, not unlike those of China. The architecture, however, was pleasing to the eye and of exceedingly substantial build. The vast concourse of buildings and temples, he says, is at once a citadel and a palace crowning the sacred mountain Mar-bo-Ri. The temples Narzounof describes as being magnificent edifices, all of gilt roofs. They lead up to the Potala, the residence of the delai-lama, the head of the Buddhist religion. It seems that the city's resources are derived nearly exclusively from the vast throngs of Buddhist pilgrims that visit the city every year and that little commerce is carried on in the holy municipality.

Narzounof found that the dalai-lama, who is supposed to govern absolutely all of Tibet and the Buddhist church everywhere, is really a prisoner in the great temple, the picture of which is herewith shown, and which was built by the ancient kings in the seventh century. This temple, or the Potala, stands on a sacred hill overlooking the city. Narzounof made extensive investigations into the affairs of Lassa's government and has made some startling discoveries. He learned that during the last century nearly all the dalai-lamas (grand lamas)

have died in infancy. He believes that they were put to death by the ruling oligarchy of lamas to prevent their having any active influence in governmental affairs.

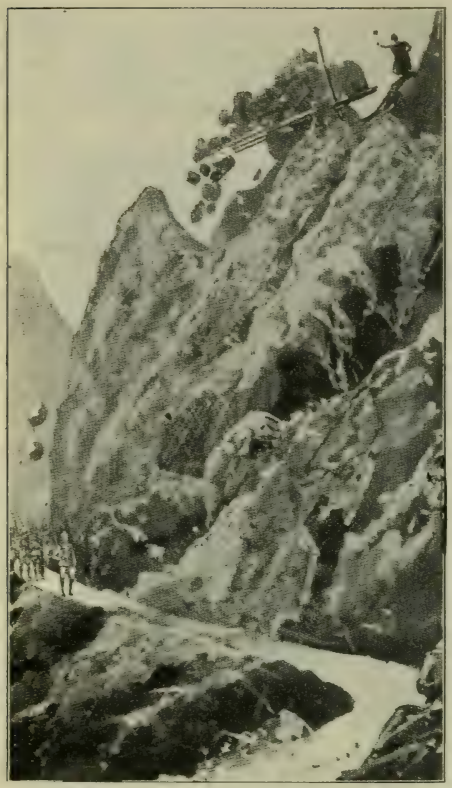
The Russian learned that when the dalai-lama dies his successor is chosen from among three youths not yet out of their teens. The Chinese emperor reserves the right to veto the election of the dalai-lama whenever he so desires. The death or sudden disappearance of a lama are of frequent occurrance in Lassa, but it is the position of the lama and not the person that the pilgrims worship and they probably rarely ever recognize the countenance of the lifeless looking being before whom they prostrate themselves in the temple. Narzounof declares the only duty of the lama is to sit adorned in gorgeous robes cross-legged before the idol of Buddha, while the pilgrims kneel and crawl before him. He says that the lama seems nearly as lifeless as the great jeweled idol below which he sits. He claims that the child is drugged before taking his seat at the idol's feet, in order to make him appear ghastly, weird and unnatural. This continuous drugging, he says, robs the poor youth at all times of all his natural impulses and inclinations and makes him appear inhuman.

Group of Residents of Lassa

A Lamassory Crowning the Hills Overlsoking Lassa

The Potala, where this ceremony before the dalai-lama takes place, is described as the largest palace in the world. Narzounof declares that it contains more than 3,000 rooms. One of the facades is nine stories high. It contains an enormous collection of Oriental art works and the largest library in the world. Here is located the "Kanjur,"

Tombs of the Lamas



A Tibetian Booby Trap.—A Rope Which Holds a Teetering Platform Loaded With Rocks is Cut and the Rocks are Precipitated in Showers on the Enemy Marching Along the Mountainous Paths En Route to Lassa

comprising more than 100 enormous volumes, said to be the direct word of Buddha; the "Tanjur," comprising 225 volumes and the Mam-kambum," or book of 100,000 volumes. The latter was compiled by Srong-Tsan-Gambo, the adored reformer of Tibet, and contains the secular law of the land. Narzounof confirms the former assertions that rites of the Masonic society are practiced in Tibet.

Home of the Dalai Lama—The Largest Palace in the World

Narzounof tells of many weird and strange customs performed by the pilgrims visiting Lassa; he describes their remarkable pigrimages over the mountains and deserts; relates their religious observances in Lassa, tells how they roll themselves on the walks, crawl on all fours around the city's walls, etc.

Expeditions that have attempted to reach Lassa before have either been baffled by the lofty mountains and blighting deserts or have been forced to retreat their steps by orders of the lamas. Dr. Sven Hedin recently attempted such an expedition. After many thrilling experiences he approached within 200 miles of Lassa. Then he was met by Tibetian soldiers, who forced him to retrace his steps; furnishing him an escort with abundant provisions to last until he was beyond Tibetian territory.

Other mysteries of Lassa and Tibet will probably be revealed in the near future as a result of the proposed British invasion, which will undoubtedly be the most interesting event of the kind in modern history. The English expedition is commanded by Col. Younghusband, of long experience in Oriental matters. It recently crossed the Himilayas into Yatung. The dalai-lama made no remonstrance and so the expedition has now advanced to Gyang-tse towards Lassa. This is within 49 miles of Shigatze, a holy city only second in importance to Lassa. According to late advices the expedition has here been checked by the Tibetian soldiers and Col. Younghusband has been forced to send back to India for reinforcements. Russia and China are greatly opposed to England's invasion of Tibet, but the British government has announced that it will not recede from its policy and proposes to open Lassa to the commerce of the world.

HAUL PASSENGERS BY THE POUND.

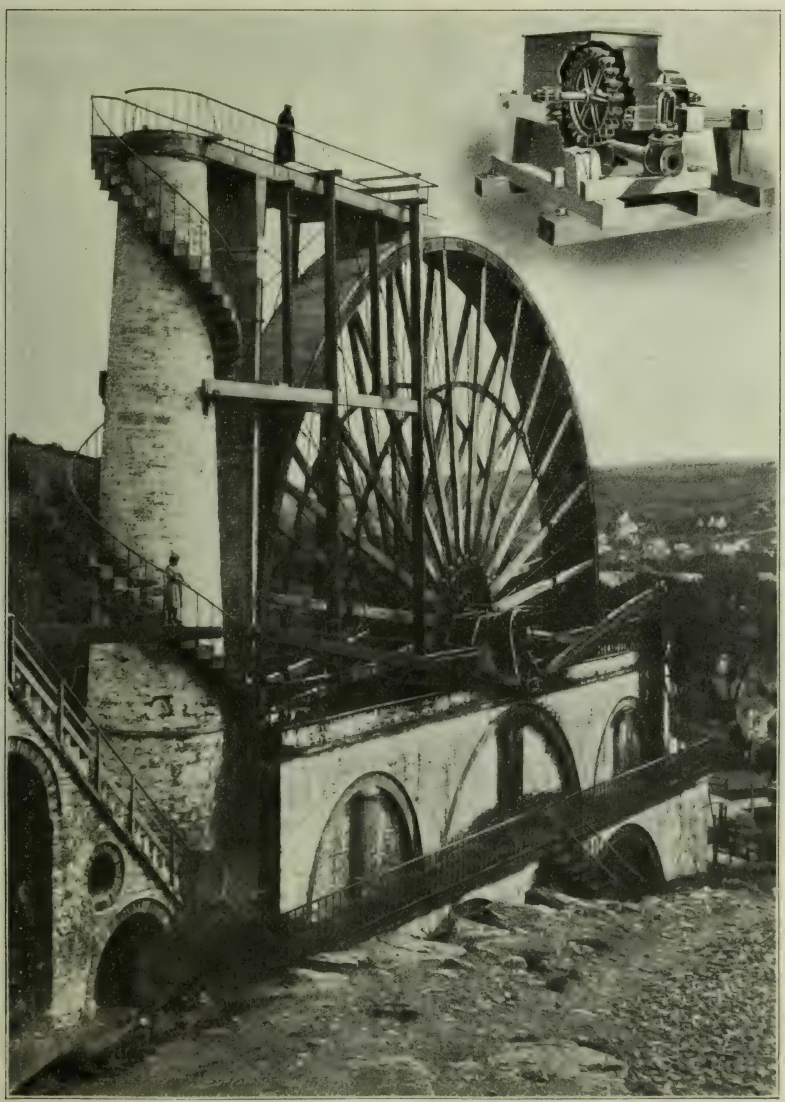
An official of the new Pueblo & Beulah Valley Electric Railway in Colorado announces that when the road is completed each person will be required to step on an automatic register scale at the ticket office and the clerk will charge for transportation at the rate of 1½ cents a pound.

This is right. Why should a small, lean man pay as much to ride on a railway car as the bulky individual of large girth and weight? The man of much adipose not only takes up more room but it certainly costs more coal or electric energy to haul him. This is an indication of the good times coming when the railroad can figure just what it costs per ton per mile to haul "freight".

The World's Two Greatest Water Wheels

Monster on the Isle of Man Has Been Running Forty Years—Troy, N. Y., Boasts the Second in Size

At the little village of Laxey, on the Isle of Man, off the west coast of England, stands a monster water wheel, that hundreds of persons every year go miles to see. It is the greatest water wheel ever built in the history of the world, and during the forty-five years of its existence has been running continuously. It is an overshot, or gravity wheel, a type now rapidly becoming extinct. The less picturesque, but far more useful and economical, turbine wheel, a product of the United States, is supplanting



The Great Overshot Wheel at Laxey on the Isle of Man, England.—Copyrighted by the Pelton Water Wheel Co.

the imposing looking overshots, much to the disappointment of the artist, but to the delight of the manufacturer.

The Laxey wheel is 72 feet 6 inches in

diameter. It develops 150 horse power, which is transmitted several hundred feet by means of rods having supports at regular intervals, to the bottom of which are attached small wheels, running on iron ways, for the purpose of lessening friction. The power thus transmitted operates a system of pumps in a lead mine, and 250 gallons of water per minute is raised to an elevation of 1,200 feet.

The water to drive the wheel comes from a distance in an underground conduit, and is carried up the masonry tower by pressure and flows over the top into the buckets. This wheel was built forty years ago, and has been running continuously every day since, never having lost a turn.

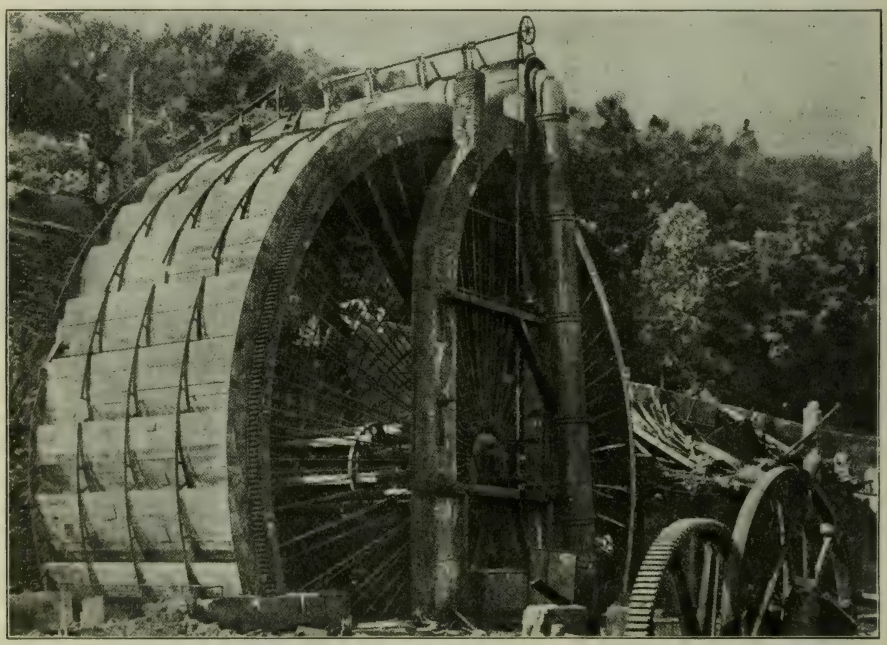
The little, unpretentious appearing machine in the upper right hand corner of the picture on page 329 shows what the present day has contributed to supplant the grand old faithful structures whose ponderous machinery, massive columns, arches and stone foundations were so pleasing to look upon.

These two wheels bear exactly the same proportion to each other in size as do the pictures, and although a mere toy in comparison, the little wheel has exactly the same capacity as the Laxey wheel, the largest in the world. The wonderful increase in power of the little American is due to the peculiar shape of the buckets into which the water is directed from one or more nozzles, so that the full energy due to its head or fall is transferred into the inertia of the wheel. The power represented by the force of the water is thus converted into mechanical movement almost entirely without friction. The buckets simply take the energy out of the stream and leave the water inert to fall beneath the wheel.

LARGEST WHEEL IN AMERICA.

Next in size to the great Laxey water wheel is the Burden wheel of America. This is at the old Burden works, Troy, N. Y. The wheel is 60 feet in diameter at or inside the buckets. The 36 buckets are 12 inches radially at the top, running to point at the bottom, and 4 feet deep circumferentially. The gear rack at each side is 9 inches face and 4½ inches pitch. The journals or trunnions are 16½ inches diameter by 18 inches long. The rods or spokes are iron, 1½ inches in diameter. There are 22 rods in each section, or 254 in all.

The wheel was built in 1848, and continued to run until 1896. It was doing good work when the old plant was abandoned, never to be resumed again. The wheel

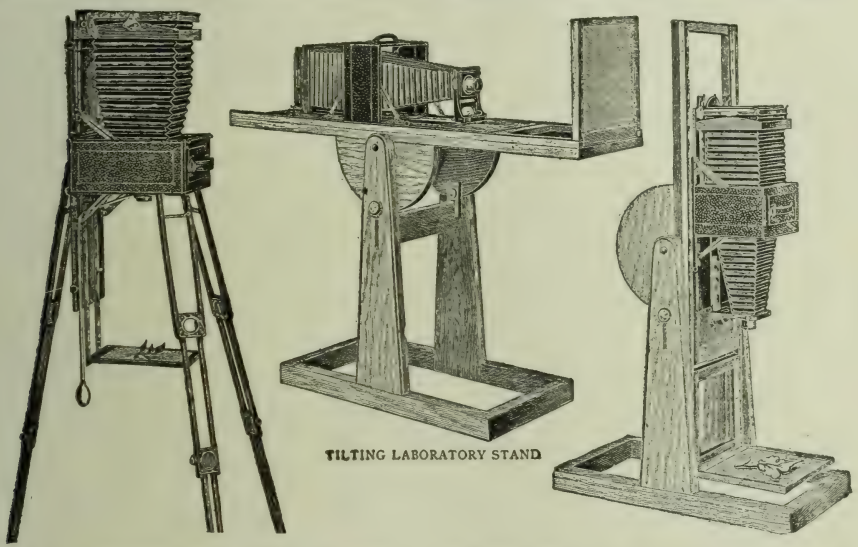


Old Abandoned Burden Water Wheel

stands today as its designer built it, with the exception of new racks, which were put on about twenty-one years ago. The wheel made two and one-half turns a minute and furnished power for the entire plant. The plant consited of one rotary squeezer and muckbar train, five 9-inch trains for rolling horseshoe and rivet iron, four horseshoe machines, six rivet and spike machines, thirty punching machines, a machine shop, roll lathes, shears and all the other machinery called for in a rolling mill.

THE NATURALISTS CAMERA.

The Naturalists camera was first made to fill an order from one of the scientific departments of the United States government. It has since come to be generally used by professors in colleges and others desiring photographic work of this character.



TILTING LABORATORY STAND

The outfit at the left is for outdoor work. The other, shown in two positions, is for laboratory use. Any of our readers could build from an examination of the picture a tilting set for home work, using their own camera for the purpose.

A method yet more simple, says Photo-Beacon, is to suspend the camera by four strings from the doorway. This answers where only an occasional exposure is required.

In Switzerland water fall have been harnessed for the production of electrical power to an enormous extent. There are now 140,000 electrical horse-power in daily service.

ONE TON OF COAL DOES THE WORK OF 40,000 MEN.

Remarkable Statement of Dr. John Perry in a Public Address at Oxford, England

"Are you aware that from one ton of coal there is as much energy, as much actual work, as may be done by 40,000 good laborers in a ten-hour day? Our best steam engines utilize only one-tenth of this energy at the present time. But even now we know that the cost of the most unskilled work done by man is one thousand times the cost of the same work wherever it may be done by the best steam engine. One fact of this kind, properly considered, is worth many long essays about the effect of the engineer in altering all the character of our civilization." These facts are contained in an address recently delivered at Oxford, England, by Dr. John Perry.

"Man is utilizing the energies of nature in thousands of ways unknown to the ancients. Common people are all getting educated. Where the ancients wondered and trembled, we understand and give orders to nature. The average unit of any population was compelled to be what we now call an unskilled laborer.

"Now our labor is becoming more and more skilled. It is labor that is the true standard of wealth. The steam engine has added incalculably to the wealth of the world. We forget that man is no longer needed for unskilled labor, so that when we use unskilled labor we are using the materials which God has given us in the most inefficient manner possible."

Great Buildings of America

The First National Bank Building, Chicago

Costing $5,000,000 containing 18 acres of floor space and 10,000 tons of steel construction, the new First National Bank building of Chicago, which houses more than $100,000,000 depositors' money, is the latest addition to Chicago's big array of skyscrapers and is one of the most magnificent buildings in the United States. Its splendid granite walls facing Dearborn and Monroe streets rise 18 stories high in majestic simplicity, the only ornamentation being slightly projecting sill courses. A marble hall of Romanic splendor is the interior space containing the First National Bank, the second largest financial institution in America. The bank occupies the space contained in the first three stories. The aggregate height of these three lower stories is equal to that of an ordinary five story building. A cornice supported on massive Doric pilasters, forty feet high, inclose the arched openings of the bank proper. Through an archway the main entrance to the main banking room leads into the grand central court. This court with its marble walls and marble seats and crystal plate glass dome fifty feet above the floor is one of the most imposing interiors to be found in any land. The court measures 60 by 99 feet and is surrounded by an arcade. The main banking room is 230 feet long, 190 feet wide and 47 feet high, 15 feet of the height facing the court being divided off into a secondary floor. There is one acre of floor space for every story. This space is divided off into offices and corridors, the corridors on every floor extending entirely around the building. The building has a frontage of 231 feet on Monroe street and 192 feet on Dearborn street, the total area being 44,274 square feet. Its height is 257 feet. There are 1,800 windows in the structure and 1,020 doors. These furnish light and egress and ingress to 983 offices. Like a city within itself the building contains its own electric lighting plant, the boilers of 800 horse power furnishing power for the 7,900 electric lights and for the running of the fourteen elevators. There is a two-story basement underneath the structure where is located the power plants, the printing offices, and other departments.

Machine Enables Us to "Feel" Music

Passes Waves of Harmony Through the Body--Is as Pleasing as Hearing

To say that you can hear a loud necktie, or see it thunder, seems scarcely less ridiculous than to say you can "feel" a new piece of music being played, yet the latter is made a reality through a new contrivance that has just been invented. Maybe the inventor's next step will be to enable us to smell the music.

"Feeling" music is made possible through an electrical device, called the "vibrochord," by which the sound is made to affect the patient's sense of touch as well as his sense of hearing. Those who have experienced the new sensation declare that music "feels" as good as it sounds and that there is all the difference in the world in the feeling of a pretty air and an ugly one. Different persons like the feeling of different tunes. Some declare "rag time" feels better than any other, while cultivated tastes prefer the feeling of classical music.

In "feeling" music the sound is conducted from the instrument to the person by means of electric wires. Instead of the sound waves merely knocking on the tympanum of the ear, as in listening to music, the waves of harmony course clear through the body, so that the tune is felt from head to foot. The device can be attached to any kind of musical instrument, so that we can feel a piano, phonograph, guitar, banjo or an organ play, or feel the blowing of a cornet or a trombone, and if a wire could be attached to every horn we could feel the music of a brass band. Those who have practiced "feeling" music have demonstrated that they can easily discriminate between the feeling of different airs as well as of different instruments. They could readily distinguish the feeling of "Home, Sweet Home," from "My Ragtime Chinaman," although they were separated from the instrument by walls so thick that the music could not possibly be heard.

Feeling and Hearing the Piano Play

This feeling of music is declared to have wonderful healing powers. It is prescribed by its inventor for insomnia, hysteria, nervous prostration, rheumatism and numerous other ailments.

The vibrochord is inclosed in a case con-

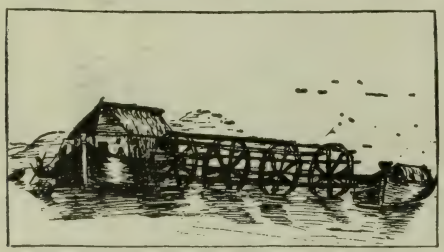
taining coils and magnets with electric wires extending to the musical instrument and to the patient. Two handles connected to the wires are to be held in the hands and the feet rest on a metallic plate.

Fred H. Brown, inventor of the music feeling machine, says: "Whenever the vibrochord is used, the human body virtually becomes a part of the instrument and does and must respond to the harmonic vibration of the instrument. The induction coil is so arranged as to utilize the harmonic beats; consequently the electric pulsations also occur in harmonic time." The intensity of the musical vibrations can be regulated to suit the person.

CURRENT MILLS ON THE DANUBE.

Floating flour mills, without steam engines to drive the rolls, are familiar sights on the lower Danube. The river has a swift current in which the barge mill is anchored.

This mill is made up of two barges with a great paddle wheel between them. The large barge contains the grinding machine, while the smaller one is merely a support for the other end of the wheel. The mill is anchored in the river, somewhere within the wheat region, and the grain in bags is brought in ox carts to the edge of the water, where it is put into small boats and rowed



Floating Flour Mill

to the mill. When all the wheat in one district has been ground into flour, the mill is floated up or down the river to other parts of the region until all of the grain has been converted into flour.

Milling done in this way is not as slow as we progressive Americans might suppose. The current of the lower Danube is very swift; and as the mill is moored in midstream, so that the full force of the water can act upon the wheel by which the grinder is operated, its revolutions are very rapid and powerful, and large quantities of the grain are milled daily. The larger boat serves also as the home of the miller and his family.

The flour made from the wheat grown on the Hungarian Plain is thought to be of such excellent quality that European bakers will pay nearly any price for it.

HIGH PRESSURE GAS DISTRIBUTION.

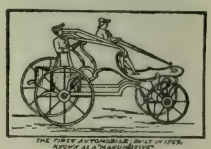
A system of high pressure gas distribution is being constructed in St. Louis, by means of which gas will be pumped long distances. The practice which has been used in natural gas lines is now to be applied to the transportation of ordinary illuminating city gas. The entire city and adjacent territory covering 65 square miles is to be served. The method has a striking similarity to the distribution and transformation of high tension electric currents.

A 300-horse-power blower will force the gas at 80 pounds pressure through specially constructed mains from which it will be supplied to the street service mains at five pounds pressure. By this method a comparatively small main will conduct a volume of gas which under the old system would require pipes of enormous size.

THE FIRST AUTOMOBILE.

Its Velocity Depended on the Activity of the Footman

The enormous contrast between an automobile of 130 years ago and of the late Parisian types as exhibited at the Paris show, is exceedingly startling, yet it is little greater than the difference between these late types and the machines of only 20 years ago.



THE FIRST AUTOMOBILE, BUILT IN 1769, KNOWN AS A "MANUMOTIVE"

The "manumotive" shown in the illustration, was built in 1769. The drawings for it were described as "Mechanical projections of the traveling chaise without horses, showing plainly, by inspection, the constitution of the machine. By John Vevherf, Master of the Boarding School of Rygate, in Surry."

The machine was worked by a footman who, stationed in a box in the rear, stood on levers and by alternately depressing each of them, propelled the vehicle by a rack and pinion arrangement, the descending lever raising the other one. The driver steered by reins, "and by the most complicated and indirect system imaginable." The description concludes with a very terse, self-evident truth—"The velocity of these carriages depends on the activity of the footman."

Dangers of Smokeless Powder

Smokeless powder has its dangers as well as advantages. While it does not reveal the location of the guns from which it is fired, and does not obstruct the vision of its gunners, it does emit a most deadly gas, which, if confined, works havoc. When used in the open field or battlements there is usually enough wind blowing to carry away the fumes, but when fired from turrets on board ship the gases are liable to be blown back into the compartment. In recent target practice by a battleship the wind blew the fumes into the turret and nearly asphyxiated the entire gun crew.

The symptoms as described by the Journal of the American Medical Association were: Convulsions, labored respiration small and irregular pulse, feeble and tremulous heart action, headache, loss of consciousness, etc., and were ascribed in a large measure to the nitric and nitrous products created by the combustion. It, therefore, becomes in part a problem of ventilation. The ship crews must be protected from these fumes by proper devices.

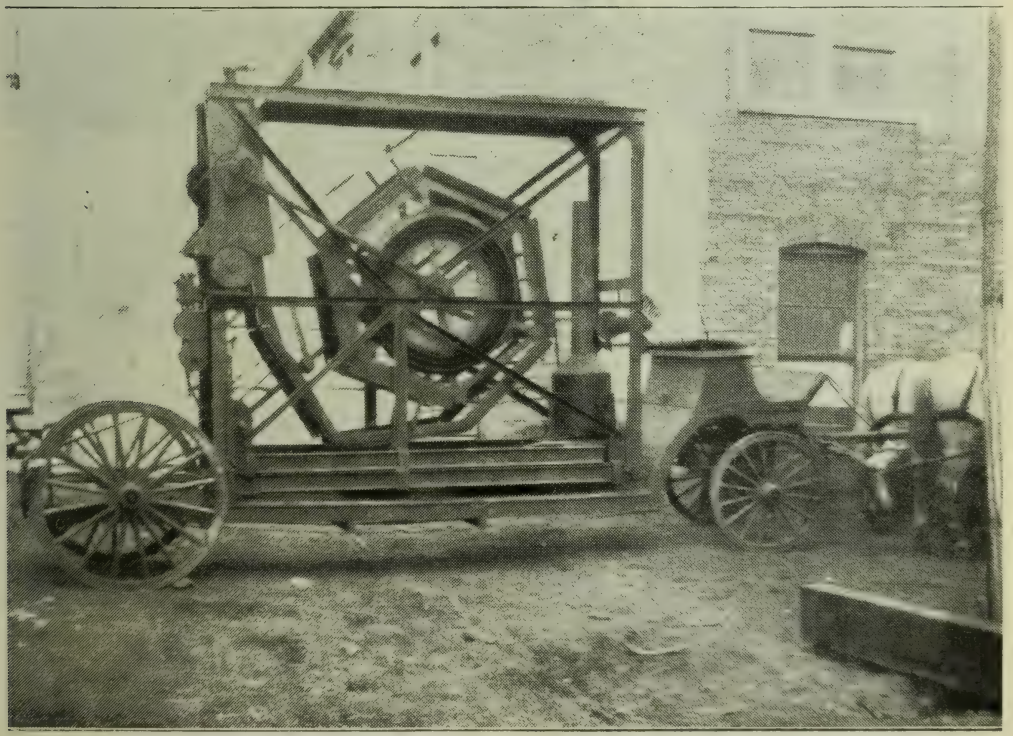
Torel, writing on this subject, calls attention to the fact that under certain circumstances smokeless powder may be more of injury than of benefit to the ship crew using it.

Novel Winding Fire Ladder

Coiled Round a Drum and is Hoisted to Top of a Burning Building in Ten Seconds

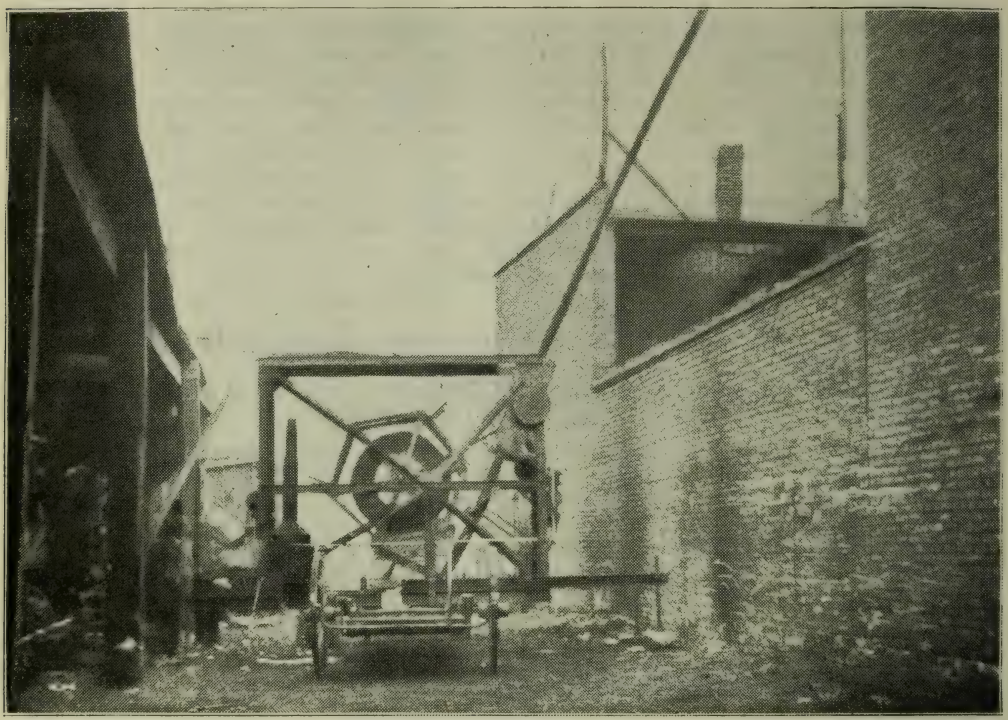
A fire ladder that is unwound from a drum and carrying two men with it shoots up to the top of an 80-foot building in 10 seconds, is a new and novel contrivance that has made its appearance in Chicago. It has been named the Copelin fire ladder.

The Western Fireman says: "The ladder is constructed in sections arranged round a drum and is shot up by the force of a small engine attached to the apparatus, the



Fire Ladder Closed

sections of the ladder locking automatically as it is raised. The apparatus revolves on a turn-table so as to give greater compactness while traveling through the streets. On arriving at the fire it is easily turned and a wide and secure base quickly established by the drawing out of supports. The apparatus is constructed entirely of steel. It will carry two men, each with a lead of hose."



Fire Ladder Extended

The illustration shows the fire ladder and truck on which it is carried, in a 16-foot alley, in which it can be turned round without difficulty. The patent has been acquired by Chicago capitalists.

A GOOD PIPE CEMENT.

A recipe for a good pipe cement for use on all classes of work up to 160 pounds pressure in air, steam or water, is given in the Engineer. To 2 pounds of powdered graphite add ¼ pint of prepared white lead and mix the whole with sufficient boiled linseed oil to make a thick paste. Apply preferably with a small stiff marking brush and keep well stirred while in use. If it thickens, add a little more oil.

RUBBER BILLIARD AND BOWLING BALLS.

Bowling balls and billiard and pool balls are now being made of hard rubber, and the attention they are attracting seem to indicate that they are destined to supplant the time-honored composition billiard ball and the lignum vitae bowling ball. A set of the billiard balls made by Richard Mason, an American, were recently sent to London, where they attracted considerable attention.

The London Mechanical Review says: "The balls are now in use in a pool and billiard room here. Apparently they are every bit as 'lively' as the ordinary pool ball, and experts who at first play with them can hardly be made to believe that they are rubber."

The India-Rubber World says: "The rubber bowling balls do not crack or chip, as do the lignum vitae balls, and when bowlers once get accustomed to them they will use no other."

WHO KNOWS?

One of our readers, H. B. Kean, Stanley, N. Y., wants the address of the Gilliams Western Foundry, which ten years ago were making a portable forge.

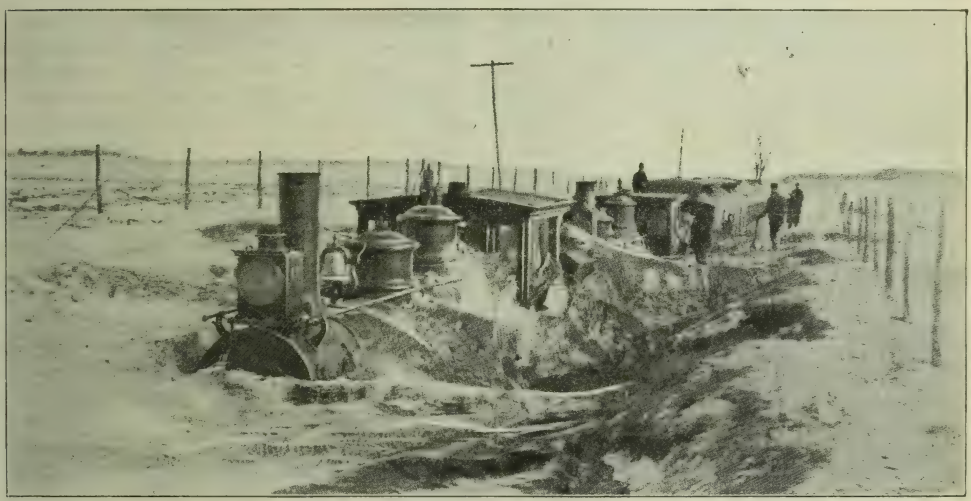
Trains Buried in February Snow

Another Month of Cold and Storms Works Havoc on American Railroads

First Engine Stalled: Second and Third Wrecked Engineers Killed

tied up completely on many lines and the most powerful snow plows in existence fought for days and nights uninterruptedly against the overwhelming odds. These snow plows, however, saved many lives, rescued many trains from threatened destruction in snow drifts and prevented a total suspension of traffic on many lines. The severity of the 1904 storms has demonstrated the great value of such powerful snow fighting machines and their manufacture will become a matter of more importance in the future.

The heaviest snows during the month of February were in Michigan and Wisconsin



Snow Blocked

Another month of awful battles with snow and ice in the United States has come and gone and with the advent of March railroad men hope for a cessation of the conditions that have taxed the capacity of all the lines in the north, east and west. The illustrations herewith produced are from photographs showing some of the familiar experiences encountered in Wisconsin. Locomotives and trains were almost ous wrecks and blockades, many of which were never chronicled in the newspapers. Many trainmen and passengers lost their lives in these terrific storms. Traffic was

Giant Snow Plow Returning from the Rescue of a Buried Train

on the lines running north, northeast and northwest out of Chicago. Not one of them and not a line out of Chicago escaped loss and delay from the terriffic storms. Popular Mechanics described and illustrated the storms of January in the preceding issue, but those of February were even more disastrous, and in fact there has been scarcely a month during the winter of 1904 that has not been marked with intense cold and destructive snows. Railroad men and shippers and passengers will long remember the winter of 1904 as one of the severest known in American history.

EASY ELECTRICAL EXPERIMENTS

A DUPLEX TELEGRAPH INSTRUMENT.

Probably every ingenious boy, who is interested in electricity, has at some time or other, constructed a simple telegraph line, and operated it in the simple manner so well understood by every amateur. The problem of sending more than one message over one wire at the same instant is a very interesting one, and while the amateur will have no great need of instruments capable of doing this, yet it is thought that the construction and operation of the instrument described below will be a source of pleasure and will throw much light upon the more interesting problems of telegraphic work. The apparatus as described is capable of transmitting two messages

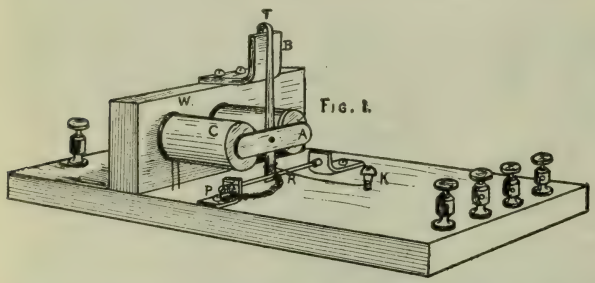


Fig. 1.

simultaneously over the same wire, the messages traveling in opposite directions.

A relay will first be constructed, which differs from the ordinary relay only in the fact that it is wound with two distinct sets of wires, and is used with these two windings opposed to or neutralizing each other. Hence it is called technically a differential relay.

A general view of the instrument is shown in Fig. 1. A baseboard should be made first whose length is 6 inches, of a thickness of ½ inch, and a width of 3 inches. At a distance of 1½ inches from one end an upright strip extending across the base is fastened, the height of this strip being 1¼ inches. It is shown at W in Fig. 1, and is to support two magnet coils, shown at C. These magnet coils are made by taking two small-head carriage bolts, ¼ inch in diameter, and fitting tightly to them 2 circular heads for the spools, the diameter of the heads being ¾ inch, and their thickness ⅛ inch. After wrapping the iron core with a layer of tough paper, the spools are wound full of No. 32 double silk covered magnet wire. These spools are wound, however, in a special manner. Having a quantity of the magnet wire wound upon two separate reels, a strand of wire is taken from each reel and wound simultaneously upon the spool so that the winding consists of two strands lying closely side by side throughout their entire length. After being wound the iron cores are joined together at the back by an iron strap whose width is about ½ inch, and of such a length that the spools when mounted on this iron strap will have a distance of 1⅛ inches between their centers. The small electro magnet thus formed is mounted to the upright strip exactly in its center. Begining with one end of the winding on one spool, this end should be conected to the first of the four binding posts shown at the right. The other end of this coil (ascertained by testing with galvanometer) will be connected to one end of one of the coils on the second spool in such a manner that a current going around the magnets would trace out an imaginary letter S. The farther end of this coil on the second spool is connected to the second of the four binding posts. In a similar manner, the remaining coils are connected up to the last of the four binding posts. This is really no different from the ordinary way of connecting the coils of an electro magnet, except that we have two sets of windings to connect instead of one.

An armature, shown at A, should be cut out of a piece of thin soft iron, and should be riveted to a thin strip of brass 3 inches long, at a distance of ⅜ inch from one end

of the strip. This end of the brass strip is soldered to a round rod shown at R, whose length is 1½ inches, and which serves as a pivot for the support of the armature and its brass rods so that the latter may move very freely back and forth in close proximity to the poles of the magnet. Accordingly this rod is filed to a sharp point at each end and these sharp points fit into sockets bored in the end of small screws which are supported by little brass clips shown at P.

About the magnets and supported by the strip W is a bent piece of 1-16 inch copper shown at B. It should be of such a length that when the armature A is very close to the ends of the magnets, the brass strip at T bears firmly against B on the front side of the latter. The strip T is bent over back of B with just enough play so that the armature A may move freely back and forth in front of C, the end of the brass strip moving through a space of about 1-16 inch. It should make contact with B only when A moves toward C, so a piece of heavy paper should be glued to the back side of B so that T can touch it only on the front side. This tongue closes a local circuit at B in the ordinary manner employed by all telegraph systems. To draw A away from C a very small rubber band may be attached just above R, the other end of which is wound around an adjusting screw K. As current must be led through R, and as the contact of the latter with its pivots is uncertain, a coil of very fine wire should connect R with P as shown.

The manner of operation of this relay is shown in Fig. 2. Of course two relays will be required, one at each end of the line. These are represented at A B and C D. Confining our attention to the former, A and B represent the two coils on our relay and K a special form of key which makes contact with the battery H when pressed down and with the ground wire W when allowed to move upward. L is the line, and R an artificial resistance connected to the outer end of A, and adjusted so as to be equal in value to the resistance of the line. Let us now examine the operation of the relay. If K be pressed downward, a current will flow from the battery H upward into the coils A and B. But if these coils are properly connected the current in coil A will circulate around the magnet in a direction opposite to that in which it circulates in coil B. Since these two coils are equal in length, and are wound together the current will not affect the relay at all. A portion will flow through R to the ground, and another portion will flow through L into coil C at the right and thence to the ground through P. This current will have its full effect in coil C and will affect coil D only by a very slight amount. Moreover, if any current goes through D its effect is added

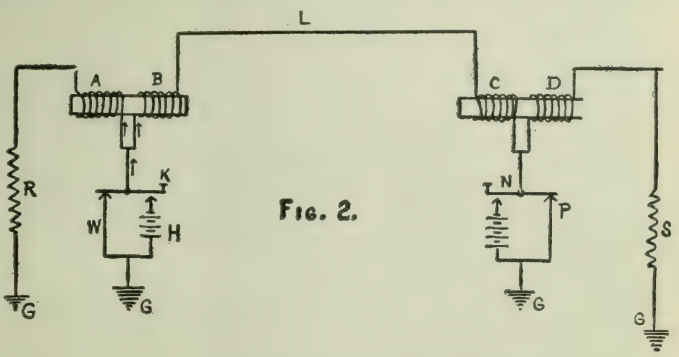


FIG. 2.

to that of C, so that the effect of the line current is to excite the relay at the right. The right hand relay, therefore, responds to signals from K alone, and the left hand relay in the same manner, responds to signals from N alone. What would happen if the two keys be pressed simultaneously? If this be the case and the batteries be equal in strength, no current will flow in the line, but current will flow through A and D, exciting both relays. But the relay at the left will be excited only as long as N is held down, and the relay at the right will remain excited only while K is held down. Thus each relay is excited only when the key at the farther end of the line is pressed and is not affected by the key at its own end of the line. If this is the case, messages may be sent by K to the right, while messages are at the same time being sent by N toward the left. An extension of these principles enables four messages to be transmitted over a given wire at the same instant.

German locomotive builders are now building from American models.

Popular Mechanics, three years, $5.

Popular Mechanics

"Written so You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.
Journal Building Chicago, Illinois

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00
Foreign Countries, post paid, - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS
JOURNAL BUILDING, : : : CHICAGO

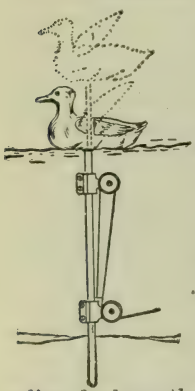
LONG DISTANCE TELEPHONE MAIN 2682

Entered at Chicago Postoffice as mail matter of the Second Class

DECOY DUCK THAT FLIES.

A decoy duck that flops its wings and goes through other life-like motions calculated to deceive the real bird, is a recent invention. Tests have shown its great superiority over the old fashioned decoy.

The mechanical duck is fastened to the top of an adjustable pole, the lower end of which is stuck in the bottom of the pond or stream. The duck is set so as to rest on the surface of the water. From the duck a strong cord reaches along the bottom of the pond to the bank or blind. When the cord is pulled the duck rises in the air, works its wings and neck and sends forth a call which cannot be distinguished from that of a live duck on the wing.



YOU CAN IF YOU WILL.

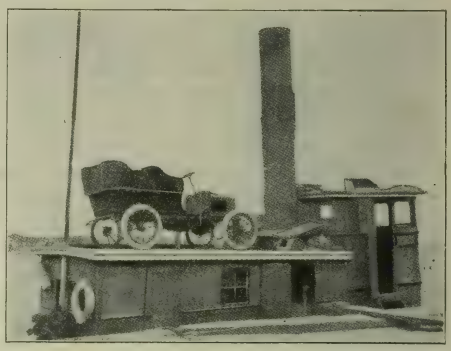
Few people realize what they can accomplish if only they determine to do a thing and stick to that decision. The persevering boy or man who never gives up will in the end show results which others more brilliant do not because they falter. John Rockefeller, jr., in an address to the young men of his bible class said:

"If you are in earnest to the innermost fibre of your body, there is no power on earth that can hold you back from the object you strive to obtain."

And he is right.

CARRIES AN AUTO ON HIS BOAT.

A New York contractor for marine construction has a tug in which he visits and inspects the work. He is also a great lover of automobiling, and carries his machine



fastened to the top of the cabin of his boat. When he has a few hours' leisure time, he lands, runs the auto ashore, takes a spin and reloads it on the boat.

ENGLISH AUTOMOBILE LIGHT.

The regulations regarding numbers and signal lights on automobiles in Great Britain are very exacting. The license number

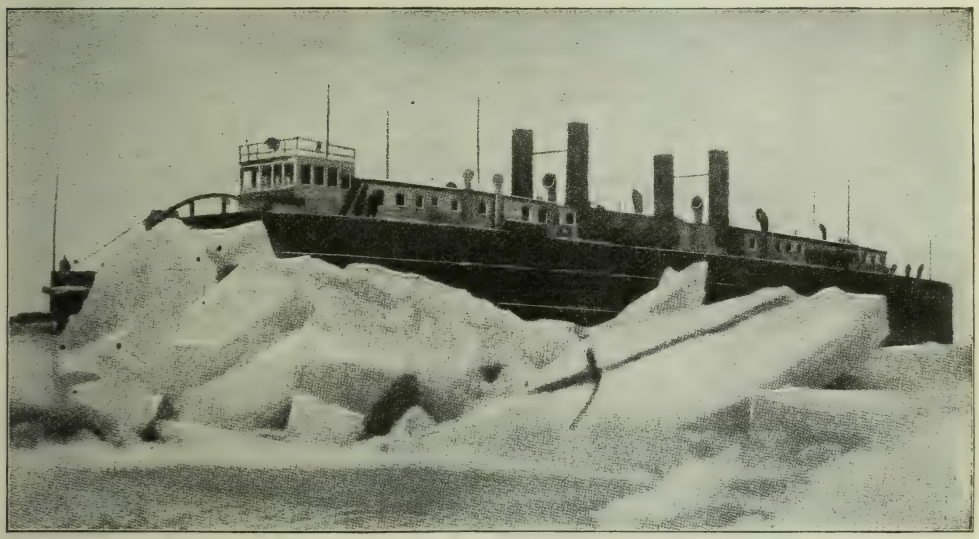
must be plainly displayed at each end of the machine both day and night. For running at night the signal illustrated is used, displaying the number and a red light at the rear and number and white light at the front.

A Michigan professor claims to have succeeded in imparting to rain water curative powers for cancer. He energizes the water from a tube of radium.

Russia Copies American Ice Crushers

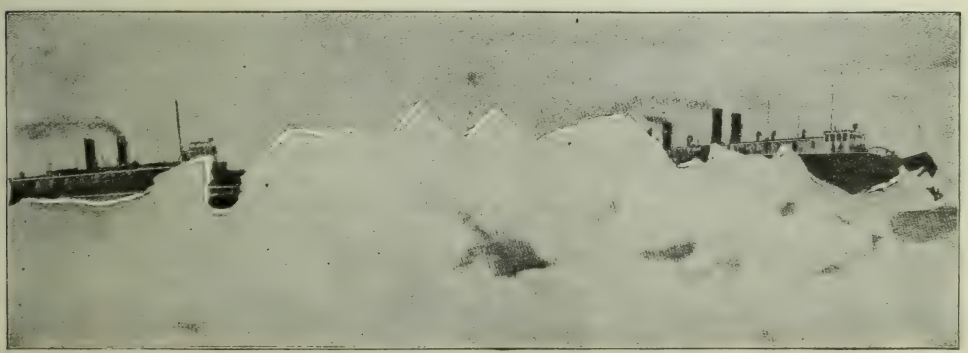
Powerful Ferries That Crush Their Way Through the Frozen Fields 30 Feet Thick in the Straits of Mackinac

Russia has adopted an American type of ice crusher for use in the Baltic Sea and in the war with Japan has found them of most valuable service in keeping the sea open for traffic in the hurried shipment of supplies. The ice breakers had their birth in the Straits of Mackinac, where the channel is frozen over four months in the year. It is these ice crushers that permit the regular operation of the railroad ferries across the water between Mackinac City and St. Ignace. When winter rages hardest, when other vessels are frozen in port, no matter how thick the ice or how cold the weather, these ferries make their trips as regularly as the days. They plow their way through the great field of ice, turning a furrow often as high as the ship. Crashing, wedging, tearing with seemingly irresistible force the ferry pauses not on its journey until the destined port is reached.



Car Ferry St. Marie Pushing Through the Ice in the Straits of Mackinac

The ice crushers built for the Mackinac service were the first of their type ever constructed. One of the ferries yet in service is the St. Ignace, the first crusher in the world to be fitted with both bow and



Car Ferries St. Ignace—St. Marie, Crossing the Straits of Mackinac

stern propellers. The bow screw dislodges the ice by the displacement of water at that end. The St. Ignace was built in 1889. She is 235 feet long overall, 52 feet beam and 25 feet deep. She has a tonnage of 1,199. Her engines are fore and aft compound with cylinders 28 inches and 52 inches diameter, by a stroke of 40 inches. She has three double-ended Scotch boilers, 11.6 feet by 18 feet, allowed 120 pounds pressure. The size of the forward wheel is 10 feet. She carries ten freight cars and her speed is 15 miles an hour.

The St. Marie is of the same general design, but is a newer and larger ship and is probably the most powerful ice crusher in the new world. The St. Marie was built in 1893. She is 305 feet overall, 52 feet beam and 25 feet deep. Her tonnage is 1,357. She has a hull of wood, sheathed with steel. Her after engines are compound, with cylinders 28 and 52 inches in diameter, by a stroke of 40 inches. Her forward wheel is 10.6 feet and her after wheel 12 feet, making 100 revolutions. She has four double-ended Scotch boilers with cylinders 11 feet 6 inches by 18 feet. The St. Marie carries 18 freight cars and her speed is 16 miles per hour.

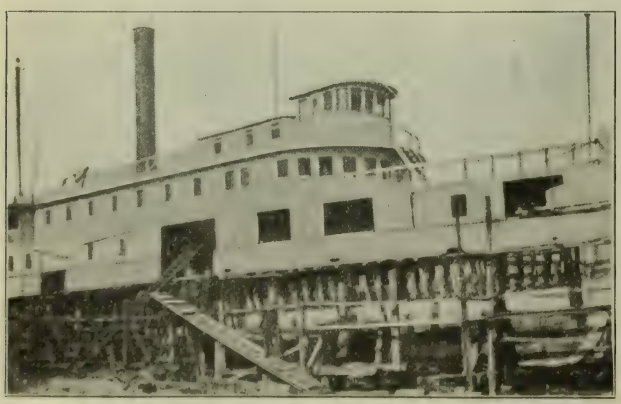
The framing of the vessels is exceedingly massive in order to withstand the great shock and pressure in cutting through the mass of ice which often extends from 25 to 30 feet below the surface. The frames are 24 inches wide and 12 inches thick. There are 15 keelsons, none of which is smaller than 14 inches square. At the turn of the bilge there are two extra keelsons 24 inches square. The extra frames at this point make an almost solid shell. The planking is 6 inches thick and the hull is nearly 3 feet thick on the bottom. The sides at the water line are protected by steel plates 2 inches thick.

SAWED A STEAMER LENGTHWISE.

The Newest Achievement in Naval Architecture

Houses have been raised and an extra story inserted, why not raise a boat in the same manner? That was the question which the owner of the sidewheel steamer Ulster asked the Erie Basin Dry Dock Co., and the builders saw no good reason for not doing something which had never before been attempted or thought of. Time and again had large ships been cut in two and lengthened, but there was no experience to guide the new undertaking.

The vessel was built of wood which somewhat simplified the task, as this made it possible to saw her in two, which was done just above the guard. When this had been done seventy-three five-ton screw jacks were distributed round her sides and inside under the decks. The upper part of the ship was lifted away from the lower part in this fashion: Workmen were placed at every third screw; when the signal to start was given, the men, moving and working as nearly automatically as possible, passed from screw to screw, giving each one, as they passed, a quarter of a turn. This lifted the boat up about one-fifth of an inch; this was kept up until the limit to which the screw could be raised was reached, when there was a space of about six or eight inches between the ship and the cribbings. By packing up the jacks and making several more lifts the necessary space of two feet was put between the two parts of the vessel. The timbers, stem and sternpost, were then scarfed and the open space planked up. The Ulster is 205 ft. long, 30 ft. beam, and of 690 gross tons.



Sawing a Steamer Lengthwise

MAKING HUMAN NOSES OF WAX.

Ugly Forms Rendered Beautiful by Mechanical Means

If your nose is out of shape, if it is too large on one side, or humpy in the middle, you can have it equalized and brought into a condition of grace and symmetry. And all this without the use of the knife or drawing one drop of blood.

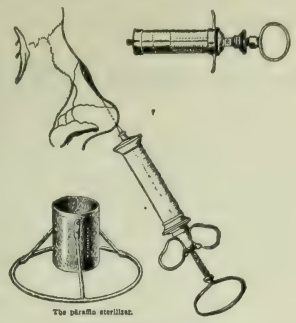
The mechanical means by which this transformation is accomplished are few and simple, although a considerable amount of

skill and experience are necessary, or the operator may make you hideous in appearance.

A special syringe and some paraffin wax constitute the equipment.

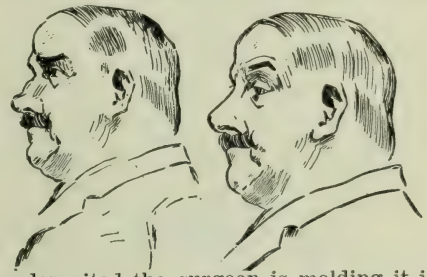
As described in the Journal of the American Medical Association, the process includes four stages: 1, preparation; 2, anesthetic; 3, introduction of the paraffin; and 4, after treatment. The preparation is highly important to the success of the effort, consisting of a thorough scrubbing of

the nose with antiseptics 24 hours previous. The anesthetic is usually a local one, of either cocaine or freezing with ethyl



Syringe and Method

chlorid. When all is ready the paraffin, which has been reduced to a fluid by boiling, is drawn into the syringe. The skin of the nose is picked up in a fold and the needle point of the syringe inserted under the skin. The point at which the injection is made depends upon the location of the fault to be corrected. The needle is inserted to the farthest point to be filled and gradually withdrawn while the wax is being injected. As the wax rapidly cools and hardens, a special syringe is required, which pushes the paraffin out by means of a screw arrangement. While the wax is be-



ing deposited the surgeon is molding it into permanent shape with his finger. Great care must be exercised not to insert any more wax than is actually required, and if not enough has been used a second operation is done to complete the work. There is considerable inflammation and swelling for perhaps 12 hours after, but no further treatment is usually necessary.

In the hands of a skillful surgeon the operation is a comparatively safe one, and the results are often so remarkable, and the whole appearance of the face so improved and changed, that the patient is not recognized even by old-time friends. The illustrations show results of actual cases, showing the faces "before and after taking."

MECHANICS FOR YOUNG AMERICA

Kites of Many Kinds and How to Make them Jug Fishing

Get your kites ready, boys, for March is here. Don't waste your time on the old style kites your father and your grandfather used to fly; surprise your playmates with a kite of new design, one that will make all the boys, and even the grown folks, look on in wonderment. Kites can be made of nearly any shape. Just bend the sticks right and paste on the paper and then paint the paper with any kind of caricature you desire.

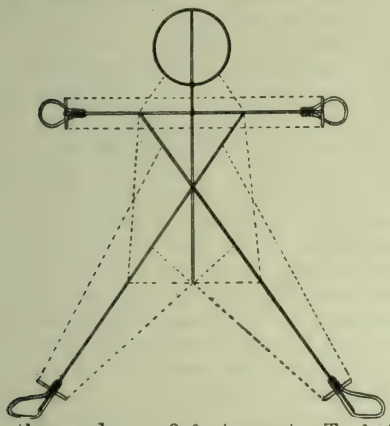
One of the prettiest of all is the butterfly kite. To make this get two thin kite sticks of equal length. Bend each in an arc, tying one end of a strong string to one

end of each stick and the other end of the string to a point about three inches from the other end of the stick. This leaves one end of each stick free, hooking over the hemisphere described by the thread and the stick. Now tie another thread to each of these free ends and tie the other end of the thread to a point near the other end of the stick, corresponding with the distance from the end at which the first strings were tied on the opposite side. This done, you should have two arched frames, each an exact counterpart of the other in size, curvature and weight. Now fasten the two frames together so that the arcs will overlap each other as shown in the sketch. Bind the intersecting points securely with thread. To make the butterfly's head, secure two heavy broom straws or two short wires, and attach them to the top part of the wing frames near where the sticks intersect, so that the straws or wires will cross. These form the antennae, or the "smellers." Then select the color of paper you want, yellow, brown, blue, white or any other color; lay it on a flat surface and place the frame on top of it, holding the frame down securely with a weight. Then with a pair of scissors cut the paper around the frame, leaving about a half-inch margin for pasting. Cut slits in the paper about two inches apart around the curves and at all angles to keep the paper from wrinkling when it is pasted. Distribute the paste with a small brush and make the overlaps a little more than ¼-inch wide and press them together with a soft cloth. When the kite is dry decorate it with paint or strips of colored paper in any design you may fancy. The best effects are produced by pasting pieces of colored paper on top of the other paper. Black paper decorations show up to fine advantage when the kite is in flight. Attach the "belly-band" to the curved sticks by punching a hole in the paper in the same manner as it is attached to the common hexagonal or coffin-shaped kite. With a tail, your kite is ready to fly.

Another interesting design is the boy kite. With light colored coat and vest and gay striped trousers, the kite standing high in the air always attracts attention and affords splendid sport for the American youth in springtime.

In making a boy kite it should be remembered that the larger the boy is the better he will fly. To construct the frame, two straight sticks, say 3½ feet long, should serve for the legs and body; another straight stick forms the spine and should be about 2 feet 4 inches long. For the arms, get a fourth straight stick about 3 feet 3 inches long. Make the frame for the head by bending a light tough stick in a circle about 7 inches in diameter. Bind

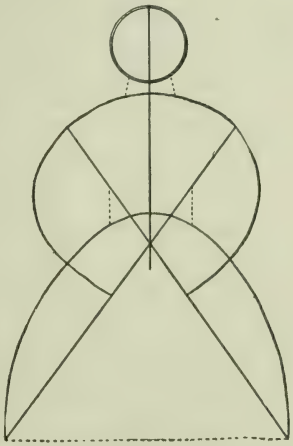
it tightly with a strong thread and through its center run the spine. Then tack on the arm stick three inches under the circle so that the spinal column crosses the arm stick exactly in the center. Wrap tightly with strong thread and tack on the two sticks that are to serve for the legs and body. The leg sticks should be fastened to the arm stick about 6 inches on either side of the spinal column, and crossed so that



the other ends are 3 feet apart. Tack them and the arm stick together at the point where they intersect. Small hoops and cross stick of the same material as the head frame should be fastened to both extremities of the arm stick and the lower ends of the leg stick for the hands and feet. See that both hand frames are exactly alike and exercise equal caution regarding the foot frames; also see that the arm stick is at exact right angles with the spine stick and that the kite joints are all firmly tied and the kite evenly balanced; otherwise it may be lopsided. Fasten on the strings of the frame, beginning at the neck at equal distances from the spine and, as indicated by the dotted lines in Fig. 2. Extend a string slantingly from the arm-stick to the head on both sides of the spinal column, and run all the other strings as shown in the cut, being careful that both sides of the frame correspond in measurements.

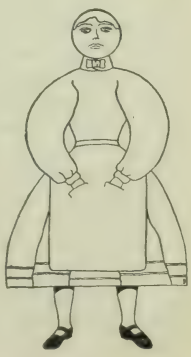
To cover the kite, select different colors of paper to suit your taste, and after pasting them together, lay the paper on the floor and placing the frame on it, cut out the pattern. Leave an edge of ½ inch all around and make a slit in this edge every six inches and at each angle; make the slits two inches apart around the head. After the kite is pasted and dry, paint the buttons, hair, eyes, hands, feet, etc., as you desire. See Fig. 3. Arrange the "belly band" and tail band and attach the kite string in the same manner as in the ordinary coffin-shaped kite.

The "lady kite" is made on the same principle as the boy kite. The frame may be made exactly as the boy kite and then "dressed" with tissue paper to represent a girl, or it may be made as in Fig. 4. Remember the dotted lines represent the



strings or thread, and the other lines indicate the kite sticks. Be careful with your measurements so that each side of the kite corresponds exactly and is well balanced. Also see that every point where the sticks intersect is firmly tacked and bound.

To cover the kite, first paste together pieces of tissue paper of different color to suit your taste. The paste should be made of flour and water and boiled. Make the seams or overlaps not quite 1-3 of an inch wide. Lay the paper on the floor, using weights to hold it down, and place the frame of the kite upon it. Then cut out the paper around the frame, leaving an edge of ½ inch. Don't forget to make a slit in the edge every 6 or 7 inches and at each angle. Around the head the slits are two inches apart, as in the case of the boy kite. After the kite is dry, paint the paper as your fancy dictates.

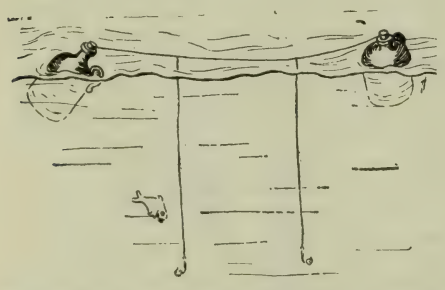


To make the breast band, punch holes through the paper, one upon each side of the leg sticks, just above the bottom, and one upon each side of the arm sticks at the shoulder. Run one end of the string through the hole at the bottom of the left limb and tie it to the leg stick; tie the other end at the right shoulder. Fasten one end of another string of the same length at the bottom of the right leg; pass the string up across the first band and tie the other end at the left shoulder. Attach the kite string to the breast band at the point where the two strings intersect. Tie the knot so that you can slide the kite string up or down until it is properly adjusted. The tail band is made by tying a string to the leg sticks at the bottom of the breast band. Let the string hang slack below the skirt and attach the tail to the center. The same general rules apply in attaching the string and tail to the boy kite.

You can make the lady look as if dancing and kicking in the clouds by making the feet of stiff pasteboard and allowing them to hang loose from the line which forms the bottom of the skirt. The feet will move and sway with each motion of the kite.

FISHING TIME COMING SOON.

Fishing time will soon be here and this year you want to have some new and effect-



ive methods of catching fish. Popular Mechanics will describe different processes in a later issue, but will tell of the "jug line" now because it is especially adapted for early fishing. Fasten two jugs to a strong line about 30 feet long. Be sure that each jug is securely corked. To the long line attach a couple or more of short fish lines equipped with proper sinkers and baited hooks. This done, place the outfit in the water and watch it, ready to follow with a row boat, or let it float down stream attached to a line held in the hand. When one of the jugs sinks or commences to bobble, you can row out to the line and pull in the fish. On the Mississippi river dozens of jugs are often thus tied together and the fisherman follows them in a row boat until he has a good boat load.

STEAM LOCOMOTIVES TO BURN ELECTRICITY.

Startling Innovation Proposed on Swiss Railways

The Swiss proposed to burn electricity under their locomotive boilers instead of coal. Switzerland does not own a pound of coal of her own; it is all imported at great expense. But she does possess the most valuable water powers in the world. The boundless snows of her lofty mountains furnish a never ending source of energy. The water falls are rapidly being harnessed and made to turn generators whence come enormous electric powers for driving the wheels of her factories and lighting her cities.

Recently some daring mind conceived the idea of placing a great white mass of electric fire under the boilers of the steam locomotives. The result will be tremendous heat without any smell, smoke or cinders. The plan is not feasible except where electric power costs practically nothing to produce. This Switzerland is doing with her water power plants.

A small wire stretched overhead in the middle of the track will carry the current which will be conducted to the locomotive by a trolley, on the principle of our own trolley cars. The prime reason which suggests this bold conception was not only to save the cost of coal now used, but also to avoid the expenditure of the millions of dollars necessary to build electric locomotives and throw out the steam engines. The changes required will be few, and the present force of engineers will need but little instruction. The "fireman" will have only to pull a lever and his work is done for the trip.

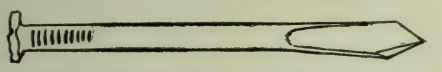
POSTAL CAMERA CLUBS THE FAD.

Postal camera clubs are becoming a fad in this country, as they have already been for several years in England and Europe. The members are made up of amateur photographers residing in different parts of the country who forward to each other interesting pictures they have taken. The prints are made from the negatives directly onto postal cards, and the collection thus secured in a few months gives glimpses of scenes from widely separated localities.

SHOP NOTES

HOME-MADE BIT.

You need never want for a small bit with which to bore a hole. All you have to do is to take a wire nail and hammer the



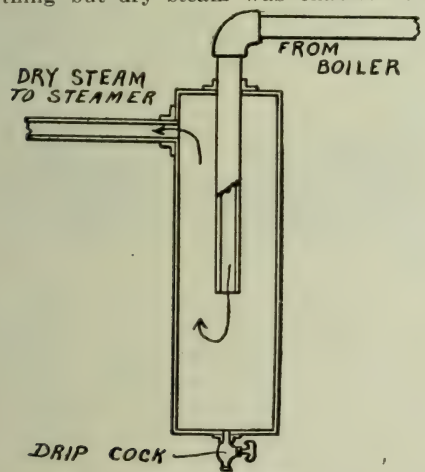
point flat, after which point and sharpen it as shown in the cut. The head is squared by a few blows with a hammer to fit the stock.

DRY STEAM FOR WHEAT STEAMER.

A writer in the American Miller tells how he made a trap for supply dry steam to his wheat steamer. He says:

Before using this wrinkle I had hard work to keep my steamer doing even work, as there was too much condensation before the steam reached the steamer. We had a standard make of steamer, but the great distance from the boiler prevented it from doing successful work.

After installing the trap I found it to be a wonderful help. The steamer receiving nothing but dry steam was enabled to do



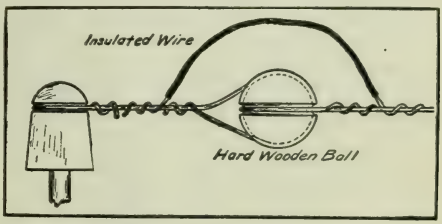
Trap for Dry Steam

excellent work. Any one adopting this plan will be pleased with results. The trap can be made by using a piece of pipe 3 or 4 inches in diameter and about 14 inches long. Cut threads on each end and screw caps on, making a drum. Then proceed to pipe it as per diagram.

ENGLISH ANTI-HUM DEVICE.

The method here described of preventing the vibration in telephone wires from being communicated to a building to which they are attached is said to be in quite extensive use in England. We quote the description from the London Electrical Engineer:

"In the fixing of wires to buildings trouble is sometimes experienced through the humming noise, and several more or less effective methods of overcoming the difficulty exist. One plan is to bind in the line wires



with strips of lead about ½-inch wide, and twist the lead round the wires for a distance of about 12 inches from the insulator. A better and more excellent method is to break the wires about 18 inches from the insulators, as shown in the figure, and insert hard wooden balls doubly grooved for making off and terminating the wires, the continuity of the wires being made by bridging over the wooden balls with a piece of insulated wire."

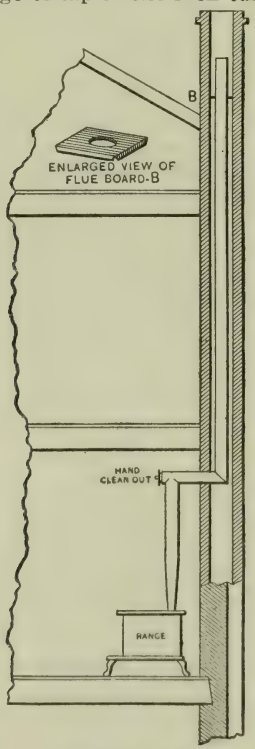
RADICAL CHANGE IN BLUE PRINTS.

A radical change is being made by the larger machine builders in their blue printing. Instead of white lines on blue paper they are now printing blue lines on white paper. The advantages are too obvious to require comment. This is accomplished at small expense by means of what is known as negative paper, which is printed from the tracing, the result being a white lined drawing on a deep, brownish-gray background. This background is opaque, while the white lines are very transparent. All subsequent printing is from the negative paper, the tracing being discarded for the purpose. This new blue print is of especial value as a substitute for original drawings, which may be preserved in their freshness.

Excellent prints may be obtained as a substitute for the ordinary blue prints to send to prospective customers. For shop use, however, the old blue print is considered the better, because the blue background soils less easily, and it is more easily read after being shop handled.

A CHIMNEY REMEDY.

Here is a method which its author, writing in the Metal Worker, guarantees to cure an obstinate chimney which refuses to draw. He accomplishes this by means of an extended smoke pipe and a flue board. Where the smoke pipe enters the flue, it is the intention that it be continued on up the flue to near the top of the chimney, where it should connect with a flue board made of heavy, galvanized iron, with a hole in it for the smoke pipe to pass through. This flue board should fit horizontally across the flue and should be made of heavy sheet iron, with an edge or lap of one inch turned up on



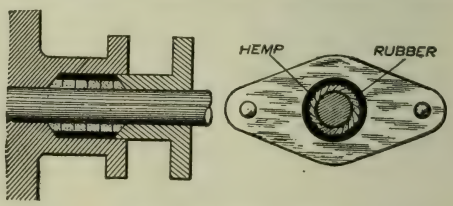
Improved Draft

all four sides, so that it can be nailed into the mortar to hold it in position. It should be the exact size of the flue, and after the pipe is connected with it, mortar should be put on the top of it to make the connection with the smoke pipe and to render the walls of the flue air tight, as well as to increase its durability by preventing rust. If it is necessary, at any other time, that another stove pipe shall connect into the same chimney flue, either a larger pipe can be used and the additional pipe connected with it by means of a tee joint; or, if the original flue is large enough, a second sheet iron pipe can be run up alongside of the other. The advantages of having a horizontal sheet iron flue board in a chimney, near the top, are that the chimney is then air tight, soon gets hot and stays hot, and therefore the draft is much more powerful. Again, it is cheap and simple, and any apprentice boy can put it up. By providing a hand clean-out to the elbow at the top of the pipe from the stove, where it turns into the chimney, as shown, the pipe can be kept clear and a full draft realized.

A SIMPLE HOME-MADE PACKING.

A description of a home-made packing which is especially adapted to piston rods that are worn and scored may be of interest to engineers. Almost every engineer has the material at hand with which to make it because all that is required is a piece of rubber hose and some hemp. The hose should be as heavy as can be obtained, says the Engineer.

To apply the packing cut off a length of hose equal to the depth of the stuffingbox, leaving about ¾ inch for the gland to enter



Home-Made Rod Packing

the box and also leave room for the rubber to expand when it gets warm. When the hemp is well soaked with cylinder oil, either braid or twist the hemp to fit the space between the rod and the rubber cushion and drive it in with a piece of soft wood until solid. Then screw up the gland tight enough to render the packing firm. When the packing gets warm begin to slacken the gland bolts so that the rod will not heat.

When starting the engine in the morning it will leak some but as soon as it gets warm the leak will stop, and when properly adjusted this packing will run for three or

four months. When renewing the packing just loosen the gland and add some more hemp.

THE VALUE OF MANUAL TRAINING.

Comparison of the Educated Youth with the Uneducated Reduced to Dollars and Cents

The boy who spends three years at a trade school overtakes and passes the one who goes directly into the shop. The following is abstracted from the Manufacturer, by the Electrical Review:

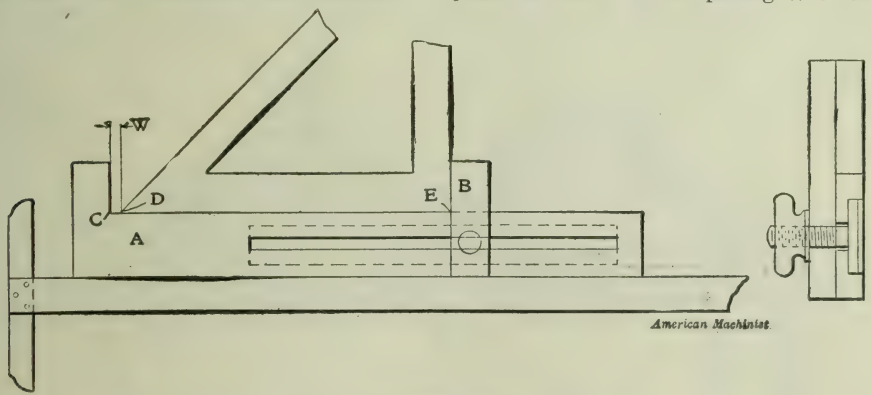
This is a more detailed study of the comparative value of manual training, as obtained in trade schools, and shop training, than was given by the author, Mr. James Mapes Dodge, in his recent address before the American Society of Mechanical Engineers. He starts with boys sixteen years of age, each of whom can obtain work at $3 per week. One set goes into the shop; the other takes a three-year course at a trade school. The potential or invested value of each—that is, the value on which his weekly wages amount to five per cent—is $3,000. The shop-trained apprentice receives an increase in wages of sixty cents per week for each six months of service, until he reaches the age of nineteen and one-half years, when his wages are $7.40 per week. They are raised to $9 a week at the age of twenty, and to $13.20 per week at the age of twenty-one and one-half, finally reaching $15 per week at the age of twenty-four. The graduate of the trade school, leaving the school at nineteen, can command a wage of $12 per week. He is then two years ahead of the shop-trained apprentice, or his invested value is $12,000, which is more than $5,000 greater than that of the shop-trained boy of the same age. His increase from this point is less rapid, but he reaches a wage of $15 per week—the maximum reached by the shop-trained—at twenty and one-half years, and is then three and one-half years ahead of the latter. His wages at the age of twenty-five are $22 per week, and his invested value is $22,000, an increase of $19,000 in nine years; and from this point he continues to rise. His average yearly increase in value at the age of twenty-five has been $2,100 per year, as compared with $1,300 for the shop-trained. The author says that of all the trade school boys he has employed, only one per cent have failed completely. The rest are still with his company and have advanced, or have left for better situations. Of the shop-trained boys, only five per cent rise above $15 per week. Thirty-five per cent remain in the employ of the company indefinitely, without rising above this point; twenty per cent leave of their own accord, and forty per cent are dropped gradually.

A GOOD SECTION LINER.

A home made section liner which is practical, reliable and quick acting is described in the American Machinist. It is made of transparent celluloid, ⅛ inch thick, though hard rubber will answer. A 45-degree triangle is used and worked as follows:

First set on piece A the movable slide B to the length of the base of the triangle plus the width of the spacing W of the section lines needed, and clamp it. Draw the first line when the point C is in contact with point D, then move the triangle to point E and piece A to point D. Two lines can be drawn now by shifting triangle. Repeat until the sectioning is completed.

Dimensions are not given, as this tool

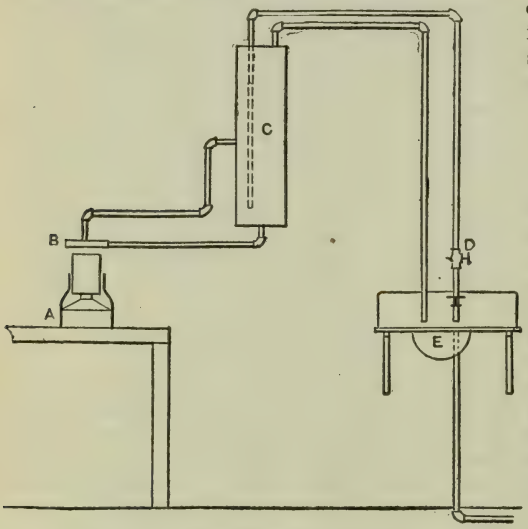


A Section Liner

should be made to fill the requirements of each individual. The construction is self-evident from the sketch. The piece A slides along the T-square as shown, and all movements of the liner can be easily made with one hand. A little practice will produce very rapid work.

HOME-MADE SHOP WATER HEATER.

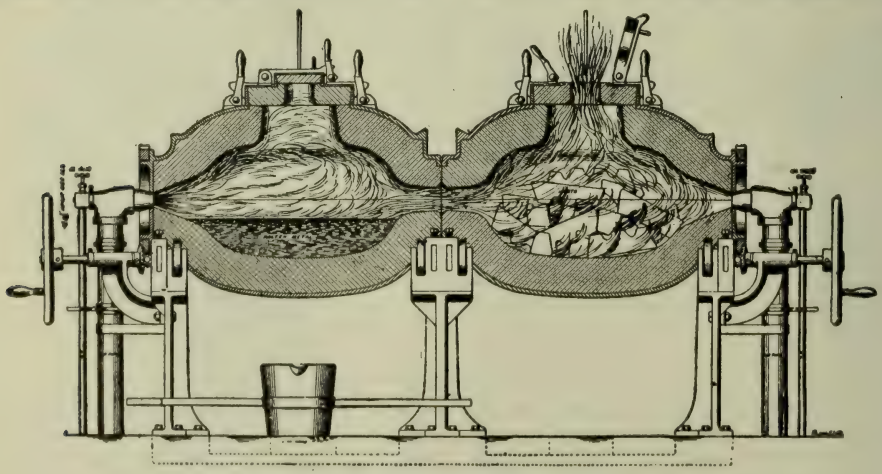
Any shop furnished with a gasoline furnace, or furnace for heating soldering coppers, can easily have plenty of hot water for washing purposes. The Metal Worker tells how one of its readers made the device: "I have made of heavy sheet metal a water heater 1 inch in height and 7 inches in diameter. From the top and sides of this heater one half-inch pipes lead to a hot water storage tank made of No. 24 galvanized iron, which is 8 inches in diameter and 30 inches high. This is securely supported to one of the walls of my shop, convenient to a wash bowl, and is connected, as shown, with the water heater by half-inch pipes. I have taken a cold water supply pipe to this wash bowl, and led it to the storage tank and connected it to a tube that runs down inside nearly to the bottom. From the top of the tank I have brought over to the wash-stand another pipe which is open at the end, and I control the water supply by using a stop cock on the cold water pipe."



Shop Heater

NEW ROTARY MELTING FURNACE.

A new style of rotary melting furnace has been put on the market, which uses the waste gases of combustion. The furnace is in two sections, and will melt two different metals at the same time, or the same metal in both chambers. Usually one chamber is filled with fresh metal while the other is in a molten state. Four sizes are made, ranging from 350 to 3,500 pounds for each chamber. The Foundry says: One of the chambers is always in the act of melting, the other receiving the spent gases which give up their heat into the fresh charge of metal in this latter chamber. As soon as one melt is poured and the chamber recharged the fire is practically continuous. It is quite reasonable that it should result in saving fuel and time and protect the metal. While the operation as a whole is rapid it will be seen that the metal is heated gradually, and that the fuel never enters a cold chamber.



SECTION SHOWING FURNACE IN ACTION.

SIMPLE OILING SYSTEM.

An oiling system which was home made at a cost of only $20 has been in successful use for several years at the power house of the electric road in Portland, Me. It was devised to avoid the use of auxiliary pumps for lifting the oil as required by gravity or compressed air apparatus. In the Street Railway Review, the manager says:

"We took a piece of heavy iron pipe about 1½ ft. in diameter and about 7 ft. long. We capped it at both ends and stood it on end for our oil pressure tank. Then to get the pressure, we merely connected the bottom of this oil pressure tank to the city water main."

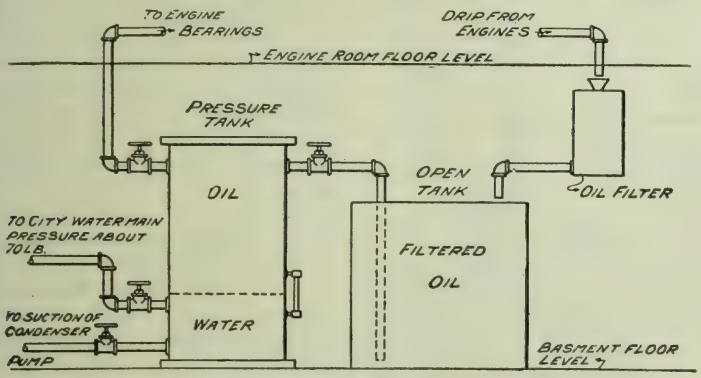


DIAGRAM OF OILING SYSTEM.

The general layout of the system is indicated in the diagram. The oil in the pressure tank floats on a stratum of water, the water coming from the main at about 70 lb. pressure. The water forces the oil up through the feed pipe leading from the top of the tank to the engine room above and to the bearings of the several engine units. The oil drips from the engines are collected in drip pans and flow by gravity to the oil filter, from which the filtered oil flows by gravity into the open tank for storing the filtered oil. From the bottom of this filtered oil tank, a connection leads to the top of the pressure tank previously mentioned. When the water in the pressure tank has risen sufficiently to force nearly all the oil therefrom, the connection to the water main is closed, and a valve is opened giving connection to the suction of one of the condenser pumps, that pump being used which happens to be working at the time. This action draws the water from the bottom of the pressure tank and at the same time draws filtered oil into the top of the pressure tank from the filtred oil storage tank.

The only attention required by the apparatus is that the level of the water in the pressure tank be watched to prevent the supply of oil from becoming exhausted and the water from rising into the oil piping system. This is not a serious task. A glass gage shows the level of water at all times. A compressed air system to do the same work would have cost $1,500. If the city water pressure should ever fail connection can be made to the boiler feed supply.

REVERSING SINGLE VALVE ENGINE.

To reverse a single valve engine put the crank on either center and scribe a line on the valve-stem next to the stuffing box; loosen the eccentric and turn it on the shaft until the mark in the valve stem is again even with the face of the stuffing box; tighten the eccentric and the engine will run in the opposite direction to what it formerly had. Care should be taken not to move the stuffing box during the operation and to see that the crank is still on the same dead center when tightening the eccentric that it was at the outset.

A HEAT PROOF PUTTY.

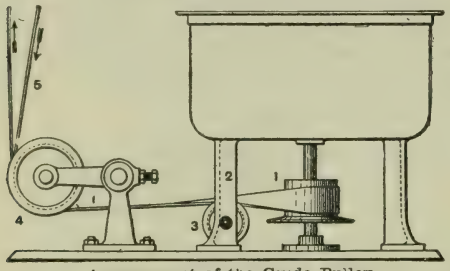
Mixing a handful of burnt lime with 120 grams of linseed oil, boiling down to the usual consistency of putty and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun's rays, yields eventually a very hard putty. When required for use it is made plastic by holding over the funnel of a lamp; on cooling it regains its previous hardness.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

AN INGENIOUS GUIDE PULLEY.

After a number of machinists had endeavored to prevent a belt from running on the flange of a small pulley on an extractor used in a laundry for wringing clothes, and which on two occasions had broken the flange as well as destroying the belts, an idea struck me that by placing a guide pulley underneath the belt and a little higher than the flange it would have a tendency to alleviate trouble. Thus writes a correspondent to the Engineer.



Arrangement of the Guide Pulley

So I made a pulley from an ordinary 3-inch pipe socket. I first plugged it with wood, then drilled in the center for a ½-inch pipe and in the end of the plug I drilled a hole, and also through the pipe, for an oil hole. Then, after finding a suitable bolt I drilled and tapped one of the legs of the machine and mounted the pulley on the bolt. It has answered the purpose very well and is running satisfactorily.

A BLUEPRINT PAPER FOR BLUE LINES ON A WHITE PAPER.

The following process, credited to Captain Abney, yields a photographic paper giving blue lines on a white ground:

Common salt	3 ounces.
Ferric chloride	8 ounces.
Tartaric acid	3¼ ounces.
Acacia.	25 ounces.
Water	100 ounces.

Dissolve the acacia in half the water, and dissolve the other ingredients in the other half; then mix.

The liquid is applied with a brush to strongly-sized and well-rolled paper in a subdued light. The coating should be as even as possible. The paper should be dried rapidly to prevent the solution sinking into its pores. When dry, the paper is ready for exposure.

In sunlight, one or two minutes is generally sufficient to give an image while in a dull light much as an hour is necessary.

To develop the print, it is floated immediately after leaving the printing frame upon a saturated solution of potassium ferrocyanide. None of the developing solution should be allowed to reach the back. The development is usually complete in less than a minute. The paper may be lifted off the solution when the face is wetted, the development proceeding with that which adheres to the print. A blue coloration of the background shows insufficient exposure, and pale-blue over-exposure.

When the development is complete, the print is floated on clean water, and after two or three minutes is placed in a bath, made as follows:

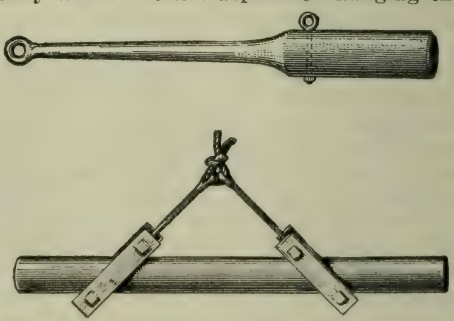
Sulphuric acid	3 ounces.
Hydrochloric acid	8 ounces.
Water.	100 ounces.

In about ten minutes the acid will have removed all iron salts not turned into the blue compound. It is next thoroughly washed and dried. Blue spots may be removed by a 4 per cent solution of caustic potash.

The back of the tracing must be placed in contact with the sensitive surface.

BLACKSMITH'S RAM.

Every blacksmith shop should have three rams, according to the Blacksmith and Wheelwright. The rams are used for butt welding. One should be of soft steel, three inches in diameter; another forged from a piece of 4-inch cold rolled shafting; and a third from five or six-inch shafting for heavy work. Do not depend on hanging the



Blacksmith's Ram

ram by a rope passed around it. Drill a hole clear through and use an eye-bolt, as shown in the first cut, or use two clamps, as in the second cut. Never use screw-eyes, as they are sure to break off at the critical moment.

If the end of the ram is to be hardened for use on cold iron, the layer of steel

should be a little thicker—say ¼-inch—and it may be hardened by means of a hose attached to a hydrant or tank of water so as to give a good head to the steam. The trick of hardening large pieces of metal is to keep the cold water in contact with the metal to be hardened. When a large piece of steel is heated and plunged into water, steam is generated which very effectually keeps the cold water away from the hot metal, therefore the cooling of the steel is so slow that a sufficient degree of hardness cannot be obtained. With the hose, a powerful stream of water is at all times forced against the steel, and the steam is forced away as fast as generated, the cold water constantly reaching the steel and carrying away the maximum quantity of heat possible. When a hose is not available, procure a half-a-dozen pails, fill them with water and stand them handy. Place the ram hot end uppermost, and let two men man the pails of water and keep a large solid stream constantly flowing upon the end of the ram, which can be made quite hard in this manner.

LOCOMOTIVE SPARK PREVENTER.

The Germans are fostering their forests, and in pursuance of this policy are taking great precautions against forest fires. Their locomotives all carry spark arresters which, while retaining the sparks have caused some trouble in choking up the escape. A recent

Spark Arrester

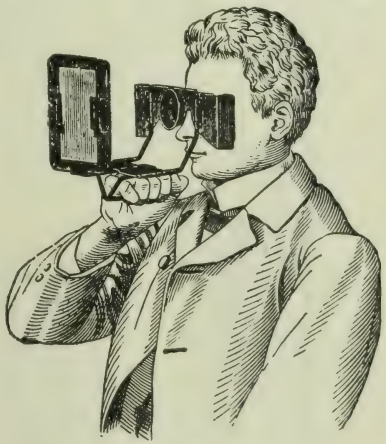
invention consists of three grates, set one above another in a square iron or steel frame of proper size to fit into the smoke chamber of the locomotive. Each bar is two inches wide by one-tenth of an inch thick. The middle tier contains twice as many bars as the top and bottom tier. No spark or ember larger than 16-100 of an inch can escape and these are so small they are self-extinguishable in going a few feet. The bars readily expand and contract.

ALUMINUM CONDUCTORS FOR ELECTRIC LINES.

Alton D. Adams says that the inferiority of aluminum as an electrical conductor in terms of sectional area is more than offset by its superiority over copper in terms of weight. For equal resistances the weight of aluminum is only one-half as great as that of copper wire of the same length. When the price per pound of aluminum is less than twice the price of copper the former, he says, is the cheaper for a transmission line of any required length and electrical resistance. The principal demerits of aluminum are its liability to oxidation when exposed to the fumes of chemical works and its liability to corrosion in moist air when it is impure, especially when it is alloyed with sodium. It is also hard to secure soldered joints.

THE VERANT—NEW INSTRUMENT FOR PHOTOGRAPHERS.

The Verant is a new instrument for photographers by which the apparently ludicrous perspective caused by short focus is overcome. It was recently exhibited and



The Verant

exploited before the Royal Photographic Society by Dr. Moritz von Rohr, who said:

"Summing up, we come to the following conclusions: Supposing we have a Verant lens of the focal length of the camera objective, a normal eye will obtain, through the Verant, as far as perspective and accommodation is concerned, the same impression it would obtain from the natural landscape when brought to the place of the entrance pupil of the camera lens. And if color is neglected the impression caused by the photograph will exactly correspond with that exercised by the natural objects.

"This necessarily affects our apprehension of relief, and our estimation of distance must correspond with the conclusions we should derive from monocular inspection of the objects themselves."

Lathe Attachments

Copyrighted 1904 by W. W. Wood.

Part I. General Introduction and Description of Division Plate and Pointer,
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle.
Part V. Gear Wheels and Rotary Cutters.
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

PART II.—OVER HEAD GEAR.

The apparatus about to be described, which is termed overheads, is designed to impart motion to rapidly revolving cutters, milling wheels and the like, and when a

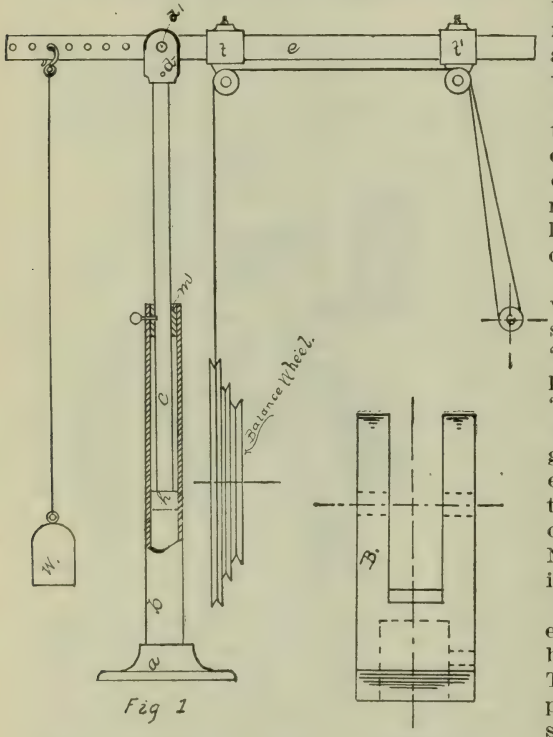


Fig 1

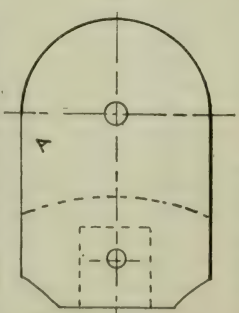


Fig 2

lathe is fitted with such appliances its capacity is vastly increased. In its most primitive stage the overhead consist merely of a roller from 18 to 24 inches long and 4 to 6 inches diameter, usually running in bearings above the lathe, driven from a belt running to the fly wheel of the lathe and by another belt driving the cutting machinery before mentioned. I have at times, when in a hurry, rigged up a pulley on the wall or on a bench back of my lathe and thus made an impromptu back shaft that answered a very good purpose.

The overhead I am about to describe in this article is very simple and easy to make, requiring but three patterns, some old pipe and iron rod, but will do a large amount of work nevertheless.

Fig. 1 is a semi-sectional view of the entire apparatus, showing the balance wheel of lathe and endless belt running therefrom over the movable pullies f and f 1 and rotating the pulley G, which is the controlling pulley of a milling cutter or other machine supported on the slide rest of lathe.

In Fig. 2, A and B is the side and end view, enlarged, of top fork for holding the swinging bar E. Fig. 1 and Fig. 3 "a" and "a1" is the side and end view of movable pullies "f" and "f1" which slide on the bar "E," Fig. 1.

To make the overhead procure a piece of gas pipe b Fig. 1, about 1¼ in. inside diameter and 3 ft. 6 in. long and screw it into the foot or step a Fig. 1. Your plumber will cut the pipe and screw it for a small sum. Next, get a piece of iron rod or mild steel ¾ in. in diameter and about 4 ft. long.

Fit a collar "h" Fig. 1 that will just slide easily but not loosely in the gas pipe and bush the upper end of gas pipe as at "m". The rod can be raised and lowered in the pipe and held at the proper position by the set screw shown at "o". At the upper end of rod fit the forked bearing for the bar "e" to swing in, supported by the pin "d-1". The forked bearing and pullies are both best cast out of brass, though iron will do, the former metal being easier to work. The bar "e" Fig. 1 is of iron 1¼ by ⅜ inches and 4 feet in length and is hung as shown by the pin "d-1", holes being bored at intervals of 1½ inches from the end through which a hook is inserted, a string from the hook holding a weight, "w", which serves to keep the belt tight at all times regardless of the distance the driven pulley "G" is moved by the slide rest.

The pullies "f" and "f-1" are easily made, but as some reader may not be familiar with the necessary operations, especially the making of the patterns, I will explain this part briefly.

I have shown an end and side elevation of the hanger at Fig. 4 and also marked the core prints. White pine is the best wood for pattern making, but poplar, or almost any close grained wood will do for the work in hand. Cut the wood to shape shown leaving the core prints where indicated. Core prints are made on patterns and the cores are made of corresponding length

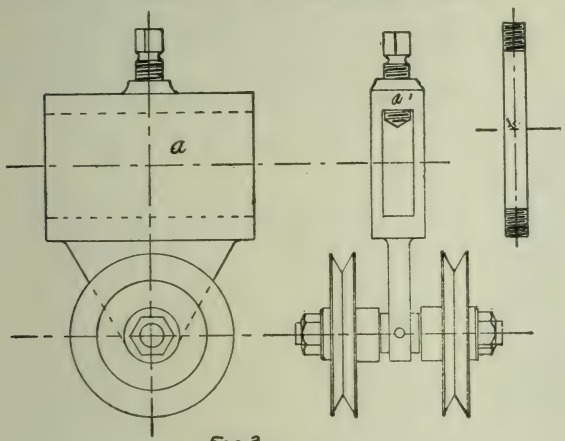


Fig 3.

over all so the metal, when poured in the moulds, will not break down the cores and form a defective casting.

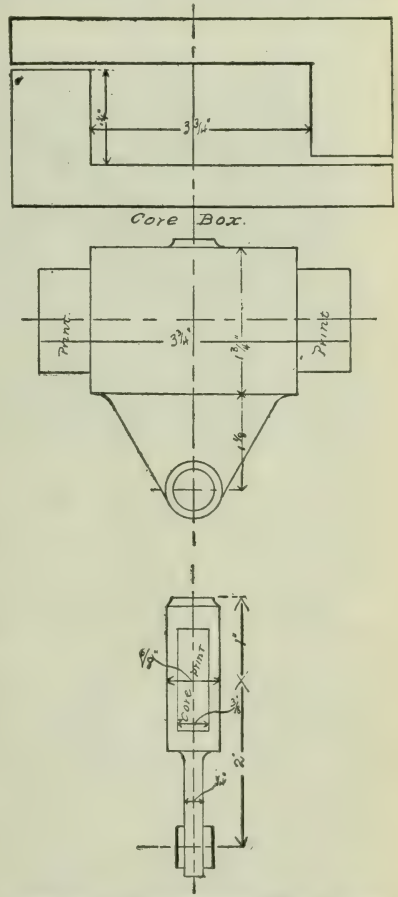
OVER-HEAD GEAR.

The core box is made of two pieces of pine ⅜-inch thick and so cut away that a rectangular hole or box is made when the two pieces are placed together as shown, 1¼ by 1¾ by ⅜ inches deep. The patterns should be sandpapered very smooth and varnished with shellac varnish, the core prints being painted a different color so the moulder will know that the casting is to be cored out and not made a solid casting.

The pulley wheel patterns are made as shown in Fig. 3 except that the grooves in the periphery are not cut, the edge being left solid and the V's cut out from casting after the hole for spindle is bored and while casting is mounted on a mandrel between lathe centers. "b" Fig. 3 shows the shaft or spindle on which pulleys run. It is made from ¼ inch and is secured by drilling a hole right through boss of hanger and shaft and driving in a pin.

The overhead I have shown will do almost any work that can be attempted on a small lathe. It is designed to be secured to the floor by screws through the base, but by changing it slightly it can be secured to the lathe itself. I have used a 3-16 in. round leather belt successfully.

Another form of overhead much in use is made with two uprights and a cross piece at top, all made of gas pipe. A horizontal shaft, supported in bearings at the ends which are in turn supported about 8 inches from top of uprights, carries a pulley at the left end in a position over the fly wheel of lathe and is driven by a belt



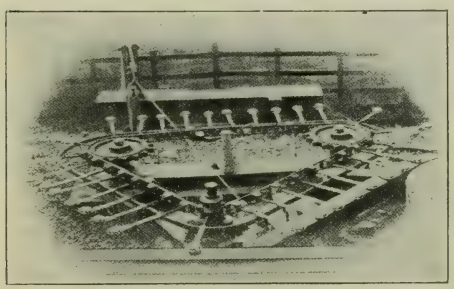
Detail of Patterns & Core Box.

from fly wheel. On the right of fixed pulley a cylinder of wood about 18 inches long is secured. A belt runs over this and a pair of weighted tightening pulleys and down to the pulley of milling cutter or other machine to be driven. The two uprights can be secured from the floor or be secured in sockets fastened on frame of lathe and should be of such height as to allow of reaching the moving parts easily

while standing on the floor. In the next article will be given a description and drawings of a simple device for carrying the rotating cutters used in cutting small gears, fluting taps and similar work.

MACHINE TO PLACE TORPEDOES ON RAILWAY TRACK.

The frequency and density of fogs in England have led to the general use of torpedoes for signaling purposes. So many are used a machine has been built to place them



Automatic Torpedo Placer

upon the track. The construction of the device will be understood from the illustration. It is operated by means of wires worked by levers in the nearest signal tower. One filling of the machine furnishes thirty-six torpedoes, and an electric indicator in the tower shows when the torpedo explodes and how many remain unused.

RAILROADS USING BLOCK SYSTEMS.

The numerous fatal railway accidents of the past winter have attracted general attention to plans for safeguarding the operation of passenger trains. The daily press has insisted on the use of the block system being made compulsory by national legislation.

It would appear that a very fair start has already been made in the use of the block system. Eighty-three roads have it in whole or part, covering 39,281 miles.

HOW TO BUILD A SMOKE HOUSE.

Where the householder has room in the back yard available for the purpose one of the luxuries of living is to have a smoke house and cure your own meats. The expense of building one is small and it will last for years. The main point to guard against is hot smoke, which dries the meat and hardens it. The Rural New Yorker recommends a house of brick or stone, though wood will answer. It should be 6 by 8 feet on the floor and about 7 feet high.

The house is best set on posts two or three feet high, by which it is safe from burrowing vermin. The smoke is made in an adjoining fireplace, built in the form of an oven, arched over on the top and needing no building to protect it, or the fire may be made in a stove under a shed or in any convenient way by which green hard wood, corncobs or other clean vegetable fuel may be burned slowly so as to make a dense clean smoke. The smoke is carried into the house as low as possible by a common stovepipe fitted in the top of the fireplace or stove, and this pipe should be long enough to cool the smoke and condense the more acrid of the acid vapors which would spoil the fine flavor of well-smoked meat. The smoke should be cooled so that there will be no drip of this acid in the house. Ten feet of pipe exposed to the open air under cover of a shed or open roof or inverted V cover will ensure the proper heat of the smoke. Green wood of any kind except pine may be used to make the smoke, and the fire should be kept low to make smoke rather than heat. The hardwood chips gathered in the woodyard, corncobs, any waste clean fuel in fact may be burned, and the smoking is best done on a still damp day, when a dull fire may be easily kept. A windy day, like other kinds of blustering, does very poor work. A low steady smouldering fire does the best work. Smoke one hour a day for 10 days. This will give—with good work in the way indicated—a very fine-flavored bacon or smoked beef or sausage.

Lots of good features are being added to Popular Mechanics. The electrical experiments, ever popular, continue with increasing interest. The department of "Mechanics for Young America," is proving remarkably pleasing to the boys. Next month we will tell them how to build boats. "Great Buildings of America" contains a picture and description of a different building each month. "Lathe Attachments" contains information that is invaluable to the users of small lathes, and much of interest to those who use large ones. And the ten pages of "Shop Notes" which have caused Popular Mechanics to be regarded almost as a necessity among craftsmen, are getting better, more enlightening all the time. You are sure to get a dollar's worth of information out of Popular Mechanics before the year is out.

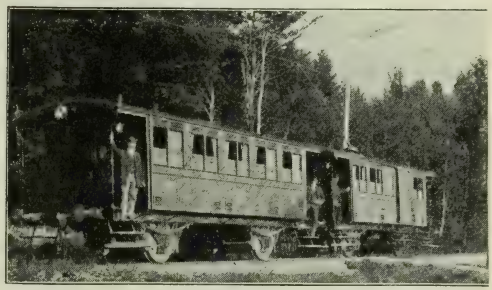
Electric Feeders to German Railways

Regular Coaches Switched off and Hauled by Trolley Cars Without Changing Passengers

In Germany and other countries of Europe short branch lines of railroads are now being operated almost exclusively by electricity. The change from steam has resulted in savings of millions of dollars to the railroads, and the change has been as agreeable to the public as it has been remunerative to the companies. As a further economy, waterpower is employed wherever possible to generate the electricity.

Dam of Power Generating Plant

The illustration shows a motor car and trailer and a power generating plant employed by the Ulm and Friedrichshafen railroad of Germany. At Meckenbeuren on this road a short line branches off and runs to Tettnang, a distance of not quite three miles. This short line is now operated by electricity, and is an example of the many that have been similarly transformed from steam of recent years. The regular passenger and freight cars of the main line are hitched to the electric car and hauled to Tettnang as trailers. The water plant, near Meckenbeuren on the main line, furnishes power for the branch railway and also for lighting the stations and for supplying power and light to Tettnang.



Motor Car and Trailer

The Electric "Canal Mule" Has Come

Hauls Trains of Boats and Marks a New Era in Inter-State Water Haulage

Improvements in steam and electric roads instead of putting an end to canal traffic, as many predicted, now seems destined to increase the importance of such traffic and to restore state canals to their prominence as factors in state and interstate commerce. The old-time canal mule has been superseded by the electric "canal mule." It may not be long until electrically hauled trains of boats will be moving along our canals, carrying greater tonnage than the electric cars that traverse the interurban lines. The canal trains, consisting of ten or more boats, will be hauled by an electric towing locomotive which runs along the bank of the canal. Such a method of haulage has already been placed in operation on the Cincinnati-Dayton section of the Miami and Erie canal, between Cincinnati and Middletown, a distance of 42 miles. It will be employed on the entire section, 68 miles long, as soon as it is completed. An average speed of three miles an hour is attained for a string of ten canal boats, each 80 feet long, and the distances between them is such as to make the entire train about 1,500 feet long.

Power for the electric towing locomotive is supplied by a number of generating stations along the canal. The application of electricity to the towing of these boats undoubtedly paves the way for the electrification of the enlarged Erie canal in New York as well as of other canals.

Even old Egypt is being invaded by the automobile, the number of which must appear on both front and rear of each machine. Speed is limited to 10 miles an hour.

Professor and Madame Curie were awarded the grand prize of $20,000 for their discoveries in connection with radium.

The Greatest Electric Shock on Record

Receive Twenty-Four Thousand Volts and Live

Electric shock is one of the things which laugh the books to scorn. According to established theory a current of 24,000 volts should be several times fatal, and yet there are two men alive today who received this terrific shock; while recently in Pittsburg, a wet flag whose folds chanced to connect two wires, one alive with 2,000 volts, was the means of killing three people.

The accident in question grew out of some emergency repairs in the power house of the electric company at Las Paulo, Brazil. The outgoing wires carry a voltage of 24,000. The switchboard has a double set of bus-bars and while repairs were being made in the upper half, the lower bus-bar carried the entire load. The dangerous task of working among the mass of rods and wires surcharged with death was undertaken by an Italian expert, Archimedi Lazzari, and Tommie Bevan, Jr., son of the general superintendent. The escape of these two persons was so remarkable that we give the following details as related by a special correspondent of the Electrical Review, of London:

Every precaution had been taken against accidents, and, in, fact, it was over-zeal to be cautious which caused the mishap. The buses being divided, and the work being carried on upon the dead section, one of the operators, Thomas W. Bevan, Jr., son of the power house superintendent, went over to work near the live half. Archimedi, wishing to warn him of his danger, took hold of Bevan, Jr's. wrist, and leaned forward to speak with him; at the same time he had his foot against an anchor bolt of the iron framework which had just been taken down. This bolt was cemented on the floor of the gallery (the high-tension board being on a gallery), the latter being made of steel rails with brickwork arching between the rails. Archimedi leaned over too far and came too near one of the 24,000-volt bare copper wires, which was one of the secondary leads off the main transformers to the high-tension board. Immediately the current jumped on to his shoulder, passing through his body and out at his feet on to the anchor bolt. Both Archimedi and Bevan, Jr., remained transfixed, while Mr. Bevan, Sr., thinking it was his son who was on the wire, leaped into the air (in order to disconnect himself from the ground) and plunged against his son. The shock pulled both men off the wire, and Archimedi loosened Bevan's wrist, only to fall near the wire again, in almost identically the same position as before, only this time the whole current was passing through his own body, not as before, when a portion must have been shunted through Bevan, Jr. Mr. Bevan, Sr., who was thrown violently to the floor, tried to kick Archimedi's foot from under him, only to find that every time he (Mr. Bevan, Sr.) touched the stricken man's foot, his own legs were shot back with terrific force. Archimedi remained thus until the power was taken off. He must have been fully half a minute under the action of the current. He claims to have been conscious all the time, and says that he felt nothing. In fact, he was able to describe exactly what occurred, and says he felt the power taken off the first time, and then come on again, as he fell the second time near the wire. On the power being taken off he immediately became unconscious, and his mouth had to be opened with the end of a file, and a piece of wood put between his teeth to keep them apart, while his arms and legs were being worked so as to produce artificial respiration. In a little over 10 minutes Archimedi was able to walk about on a man's arm. He felt sick and had fearful burns on his shoulder and his foot, but after about six weeks' absence he came back to work and has not missed a day since. Both the Bevans suffered nothing greater than little burns over the body, wherever the current came in contact.

Just imagine the sending your lady friend a box by wire! It seems absurd, doesn't it? yet that is what they propose to do next. The "Electric Post" is the name of the device by which it is planned to send all kinds of packages and letters by electric wires. Popular Mechanics has arranged for an article on this interesting subject which will appear in the near future. Nearly everything new is written about in Popular Mechanics.

Americans Use Too Much Water

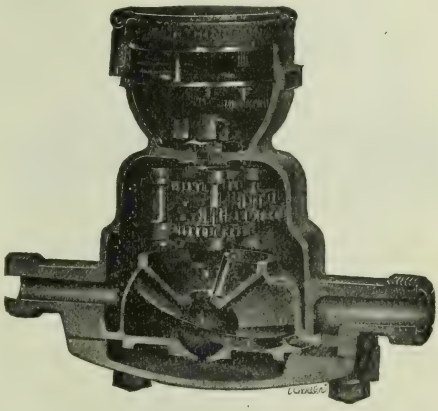
Meter System of Making Them Pay for What They Consume Being Adopted

Americans are getting so they use so much water that the plan of introducing water meters and making the consumer pay for the water in proportion to the amount he consumes is being adopted in many of the leading cities. Statistics gathered by G. I. Bailey, of the American Society of Civil Engineers, show that Americans now consume more water than any other people in the world. Starting with an average of ten gallons a day for each person under the old system of charging, it has increased, under the flat rate system, to an average of 137 gallons a day for each person in the United States. Of course, it does not require 137 gallons a day to satisfy a person in the far arid west, where the water is often carried miles.

Tests with meter measurements, making the person pay for the amount of water he uses, shows that Americans waste water; that they use twice as much as they need.

A leading manufacturer of New York city has patented a water meter that is now being used in many municipalities to measure the water used by consumers. In this meter a light disk formed of hard rubber is placed in a compartment, which may be approximately described as a hemisphere with a spherical segment taken out of the top. A slit cut in the disk upon one side fits over a vertical radial septum in the disk chamber. This is clearly shown in the accompanying cross-sectional view of the meter. The disk itself as actually constructed is conical in shape on both the inner and outer surfaces. From the center of the disk a vertical spindle projects through a circular opening in the disk chamber and its upper end rests against a circular block. It is thus constrained to move in a circle.

Now, it will be seen by examining the cut and considering the possible motion of the disk that there is never a free opening between the water inlet passage and the outlet, but that the disk is always interposed. However, since the water pressure is admitted to one side, if the pressure of the exhaust is any less the disk will be caused to tip, resulting in an increase in the volume of the portion of the disk casing opening to the supply and a decrease in that opening to the delivery. The continuation of this motion causes the vertical spindle to travel in a circular path, while the disk itself may be said to "wobble." The motion of the vertical spindle is reduced by an intermediate train of four gears, which operates a slow moving spindle extending through a stuffing box in the top of the meter casing. This spindle operates the gears moving the counter.



New Water Meter.

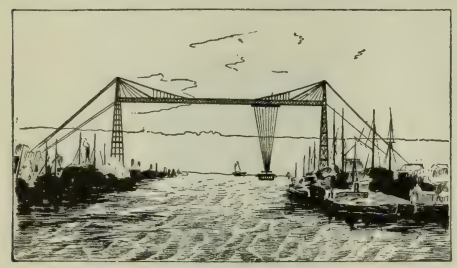
This counter may be either of the pointer-and-dial type or the straight reading type, and may be arranged to indicate in cubic feet, gallons, liters, etc., as required.

JERUSALEM HAS ITS FIRST ICE FACTORY.

An ice factory has been established in Jerusalem by an American and a German and ice is being used in that antiquated city for the first time in its voluminous history. It is a small factory, the power being furnished by an oil engine of three horse-power. The compressor is of French manufacture. The product of the factory is sold at about 2 cents a pound. The sale amounts to about 700 pounds a day. The capacity of the works is 1,400 pounds daily. The water used in rain water, from cisterns, and the ice is like crystal. When the ice was first put on the market a short time ago, the people, none of whom had ever seen ice in Jerusalem before, did not know what to make of it and the demand was small. Soon, however, the hospitals and hotels began to use it and now nearly all the foreign residents and many wealthy native families are the consumers.

Overhead Ferry at Nantes, France

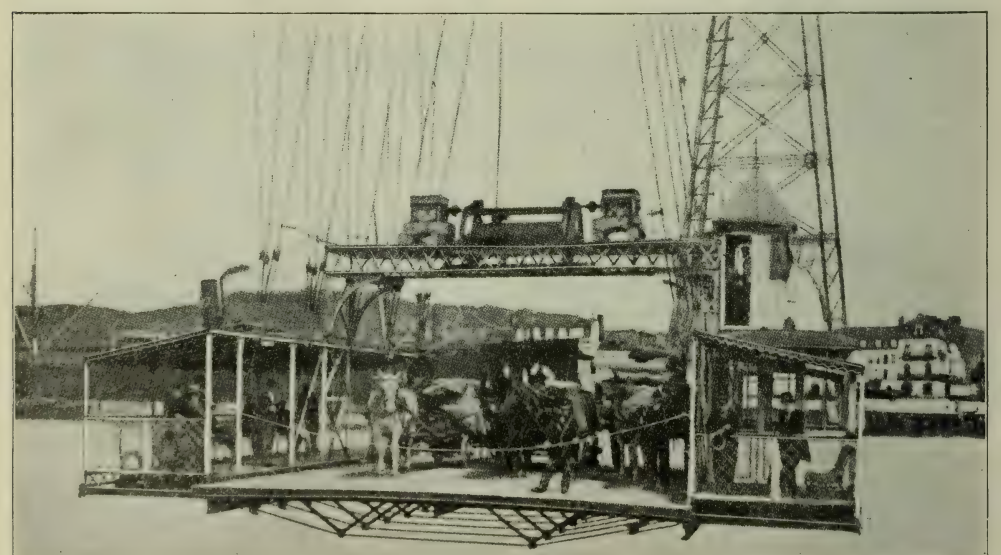
On the banks of the river Loire, at Nantes, France, rise two stately steel towers, 200 feet in height. Between the tops of these towers, at a height of 165 feet above the water, streches a suspension bridge. This bridge, however, is not used for travel of passengers, but supports steel rails on which run immense wheels, or trolleys, contained



Passengers Being Swung Across a Stream.

in a sort of inverted car. From these wheels, by means of strong steel cables is suspended the ferry in which are transported passengers and vehicles. The ferry is some feet above the water, and its movements are under the perfect control of the operator who occupies a small cab above the passenger compartment. Electricity is the motive power, and the motors are placed on the upper deck of the ferry. The ferry cost $200,000, and this unusual type of construction was chosen to avoid the long ascent and descent for the usual form of suspension bridge, which in this case was necessarily very high in order to permit ocean shipping to pass below. Passengers pay one cent fare, and wagons from five to ten cents each. The distance between towers is 490 feet.

There are similar ferries at Rouen and Martion, France; and Bizerte, Tunis.



Swinging Ferry Carrying Passengers and Freight.

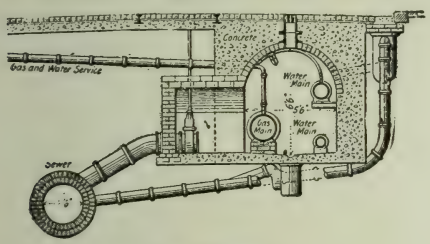
SMALL BOY VERSUS THE HORSE.

By adding a third wheel, a light steel frame and a box to the bicycle, the small boy may be employed to take the place of the horse in the delivery of light parcels. With this combination delivery cart and bicycle he makes much better time than with a basket or push cart. The invention is designed for attachment to any bicycle, without adding materially to the power necessary to propel the vehicle. The light steel frame and the third wheel support one side of the carrier while the other side rests on the frame near where the frame is clamped to the bicycle. There is, of course, sufficient space between the bicycle and the box of the carrier to permit free motion of the foot.

TUNNELS FOR PIPES IN STREETS.

Nobody will ever know how many million dollars could have been saved in the city of Chicago alone had there been constructed, say 20 years ago, pipe tunnels under the streets in the business district. American cities will come to these things some day, indeed a beginning is being made already, but we are away behind English and European cities in this respect.

The city of St. Helens, in the North of England, has an extensive system of these tunnels, or pipe galleries as they are called over there. These tunnels are built and

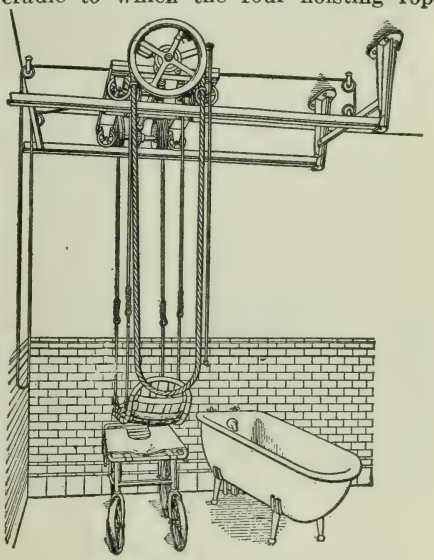


Pipe Gallery.

owned by the city, and instead of placing the gas, water pipes and various electric wires in conduits, they are all carried in the pipe galleries. The rental to the various companies for the use of the tunnels yields the city a good income, while the companies save thousands of dollars, as it is so much cheaper to run wires in the tunnels than to dig up streets and replace the pavement. Incidentally also the public is put to no inconvenience when some company wants to run wires or pipes. The pipe gallery illustrated is 6 ft. 6 in. high and 5 ft. 6 in. wide and built of concrete. At intervals are ventilating openings at the top, while large side tunnels afford ample room for receiving and handling the pipes as new lines or extensions of old ones are made. Special provision is made for drainage, even to the extent of taking care of large bursted mains, should such an accident occur. Electric lights are placed every 28 feet. The intersecting streets are all indicated by name, on plates fixed to the wall. These are only a few of the details, but will serve to show how practical and sensible such a public work can be. The large continental cities have, of course, been so supplied for many years, and it seems strange that in this country, that brags so much on its superiority, we should still go on tearing up costly pavements, digging ditches in the public streets, making a muss, obstructing travel, all to get a small pipe or a handful of wires underground. In these days of cement and underground tunnel construction, which can be carried on without anyone above ground even knowing the fact, there is no longer any excuse for American cities tearing up streets as in the past. The tunnels would more than earn their interest from the start.

BATH HOIST FOR INVALID.

The very latest thing in a bathroom is a hoist for lifting an invalid out of a chair or rolling table, swinging him over the bathtub, and then gently letting him down into the water. The device can be operated so easily that a twelve-year-old child could handle a person weighing 200 lbs., surely and safely. The patient sits or reclines in a cradle to which the four hoisting ropes



An Invalid's Bath Hoist.

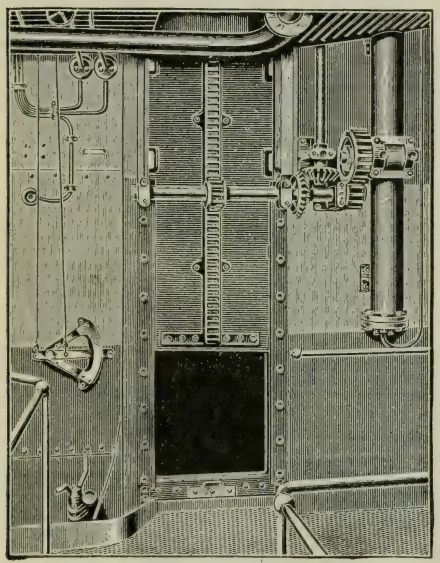
are hooked. The elevating machinery is on the same plan as the hand hoists used in machine shops. When the cradle has been sufficiently raised it is swung over the tub, and slowly descends of its own accord, a brake regulating the speed. To leave the tub the process is reversed.

SILK WORMS MADE TO DYE CLOTH.

Experiments in Roubaix, France, according to claims, have succeeded in making silk worms do their own dyeing. By feeding the voracious caterpillars on leaves containing a natural or artificial pigment, they are said to have obtained raw silk in red, blue and bright orange. Thus before long we may see "natural colored silk" made and sold, no doubt at a fancy price.

BULKHEAD DOORS IN UNSINKABLE SHIPS.

The modern steel ship is becoming more nearly unsinkable each year. The arrangement of the hull in water tight compartments separated by steel bulkheads has long since been generally adopted. With the practical application of electricity it became possible to open and close every bulkhead door in the ship by simply touching the proper buttons of the switchboard on the bridge or in the pilot house. All our latest battle ships are so constructed. There has been the terrible danger, however, that in-



Hydraulic Bulkhead Door Half Open.

cident to the excitement which must necessarily prevail in case of fire or collision which would open the ship's side, that in the haste to close the bulkhead doors some unfortunate officer or seaman might be shut into one of the compartments to suffer death by suffocation or drowning as the case might be.

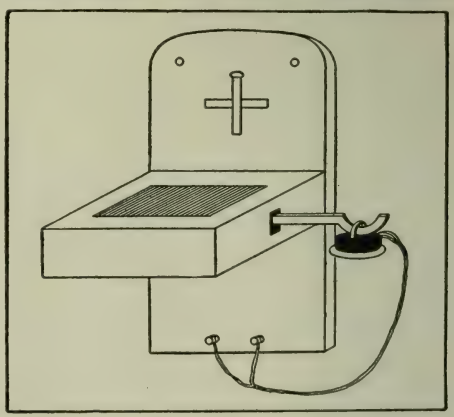
The Deutchland is admittedly one of the most perfect ships ever built, and the vessel has now been equipped with a system of operating the bulkhead doors. An hydraulic system using 700 pounds pressure operates the entire system at once by means of two valves; but any door can be worked independent of all the others. The system goes farther, however, and should any seaman be caught in a compartment closed from the bridge, he can still operate the door and escape and close it again. The illustration from the Shipping World, London, shows the working gears which operate the doors, also the hand lever at the left of the door for working the door on the spot. When a door is closing from the bridge control an electric gong sounds automatically for twenty seconds in the compartment to be flooded, which ordinarily would give time for the occupants to escape.

If the ship should spring a leak unknown to anyone, when the water reaches a certain height an automatic alarm sounds a gong and closes the door by means of a float which in rising opens a valve and sets the gears in motion, thus closing the door.

ANTIQUATED TELEPHONE IN PARIS.

The telephone system of the great city of Paris is twenty years behind the times. Not only are the switchboards of a type which have been discarded years ago by even the smallest exchanges in this country, but the telephones are something absoltuely ludicrous. The American Telephone Journal says:

They consisted of a wooden box which looked something like the sketch. A common vibrating bell is used for a signal and a push button for calling. The shaded



A Parisian Telephone.

place on the top of the lid is the diaphragm of the transmitter, which consists of little carbon sticks touching each other. To hear and see a Frenchman talk through one of these is something worth traveling far to see.

A great cantilever bridge with a clear span 1,800 feet, and railroad track 160 feet above the Strait of Canso, will be built to connect Cape Breton, N. S., with the mainland.

Light at Port Antonio, Jamaica

FOLLY POINT LIGHT at the entrance to the harbor of Port Antonio, Jamaica, is the first sight that greets the tourist on nearing that "land of smiles and sunshine". The light has long stood at the harbor entrance, but of late has been equipped with modern machinery and lenses and is one of the finest lights on the Caribbean. With its horizontal stripes, alternately black and white, the towering lighthouse serves as a guide by day almost as well as does the light by night. The Folly Point Light stands in the center of a scene noted for its picturesque appearance Crystal streams on every side rush into the sea while the spray from the lashing waves leap as high as the light. The United Fruit Company's steamers that ply between the United States and Jamaica make regular landings at Port Antonio.

TO DISTINGUISH PORTLAND FROM SLAG CEMENT.

At the Fifth National Congress of Applied Chemistry the statement was made that it was not possible by chemical means to determine the proportions of a mixture of blast furnace slag and Portland cement. H. Seger and E. Cramer, of Berlin, Germany, have investigated this statement, and find a distinct difference in the capacity of these two bodies for the absorption of water, as well as a great difference in the solubility of each in water. For instance, the mean value of a number of water absorption tests gave 11.46 per cent for Portland cement, and 0.78 per cent for slag. The solubility of the two showed fully as great a difference.

Send for Popular Mechanics premium list.

The Old Way and the New

Two story buildings are still put up something like this. The hod-carrier used to be an important factor in building.

Modern methods, however, are absolutely essential to the erection of our modern structures Less cost, more work.

Antiquated business methods, particularly in the handling of materials and freight, are just as absurdly inadequate to-day as the hod-carrier for sky-scraper building.

Particularly when one's competitors are using the quicker, cheaper, and better methods illustrated here.

Courtesy of the Electric City.

PANCAKE LEATHER.

Pancake leather is composed of thin sheets of leather pasted together and dried under tremendous pressure. The result is a strong, heavy piece of leather which to all appearances was tanned from a single hide. It is used in making parts of shoes, for the backs of brushings and a great variety of purposes. Hide and Leather tells how pancake leather is made:

"The trimmings, splits, etc., are dampened and in the moist state smoothed out and carefully laid in a form of say 12 by 16 or 11 by 26 inches, and each piece of trimming when laid into the frame is rubbed over with paste, and in this way a compact cake of a certain substance is built up, composed of nothing but layers of leather and an excellent paste which is said to have waterproof qualities. The sheet is then put under a tremendous pressure, dried and rolled, and is then absolutely solid and compact."

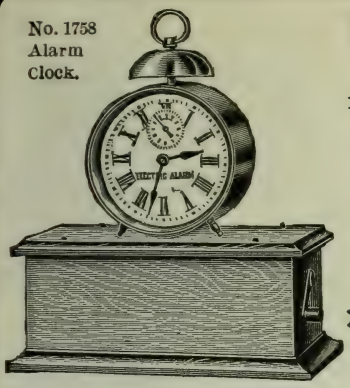
Pancake leather is much cheaper than the solid leather for which it is used as a substitute, often to the disappointment of purchasers of the manufactured goods.

ANTI-VIBRATING BICYCLE HANDLE BUFFERS.

The "India Rubber Journal," of London, says: "An anti-vibratory device for the handlebars of cycles has long been wanted and of late a great number of patents have been taken out. Rubber has been used more or less in many of these patents, but not with any great success hitherto. A new arrangement, however, strikes us as being a very good idea, and more practical than any other we have yet seen. The handlebar is pivoted in a sort of guiding-cage on the top of the stem. The rubber buffer is introduced above and below the handlebars so that all upward and downward movements of the stem are communicated to the handlebar only after it has been partially absorbed by the elasticity of the rubber. Theoretically, this arrangement is not perfect; practically, however, it does its work efficiently, and reduces greatly the vibration.

Popular Mechanics "is written so you can understand it."

No. 1758 Alarm Clock.



Electrical Novelties and Supplies

SPECIAL NET PRICES

No. 1561. Short line telephone, Ea. @$2.50
2204. Home Medical Apparatus - - - " 3.25
2215. Anti-Doc. Medical Apparatus - - - " 2.00
2240. Little Giant Medical Apparatus - - - " 1.35
1762. Electric Door Bell Outfit, complete - - " .55
Eureka Pocket Flash Lights " 1.25
Mesco Dry Batteries @10 1-2c.
178. Eureka Telegraph Instruments - - - " 1.00
3 inch Iron Box Bells - " .16

No. 18. Annunciator Wire, per lb. - - - - Ea. @$0.22

Long Distance Bridging Telephones

With 1600. Ohm Ringers, 50,000 Ohm Generators, fully guaranteed, complete Ea. @$11.00
Same with 100,000 Ohm Generators - - - " 12.00
1758. Early Riser's Electric Alarm Clock - - " 1.90

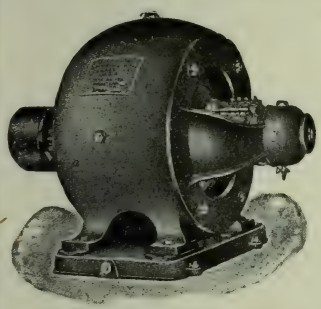
We have many other equally as attractive prices to offer.

SEND FOR NO. 16 CATALOGUE

MANHATTAN ELECTRICAL SUPPLY CO.

The Largest Manufacturers and Dealers in Electrical Supplies in America

32 Cortlandt St, 39 Dey St., New York 200 5th Ave., Chicago



Electrical Construction.....

DYNAMOS, MOTORS, METERS
ARC LAMPS, SWITCHBOARDS
RHEOSTATS and WIRING

Repairing of all Kinds

N. W. YOUNG, 52 West Adams Street, **Chicago**

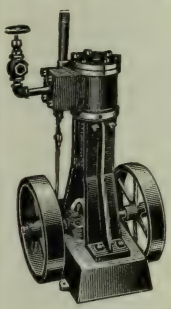
Telephone, FRANKLIN 231

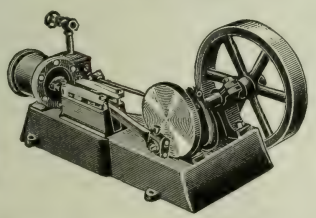
BE YOUR OWN ENGINEER

We Can Furnish You With

ENGINES

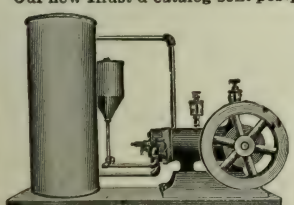
1-8 H. P. UP.





Steam Boilers, Steam Pumps, Steam Engines, Gas and Gasoline Engines

For Stationary, Marine and Automobile use. Dynamos, Motors, Electric Fans, Electric Novelties, Batteries & Supplies, Individual Electric Lighting Outfits, 8 to 100 Light. Our new Illust'd catalog sent postpaid 6c.



MARTIN MFG. CO. 180 W. Madison St., CHICAGO

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

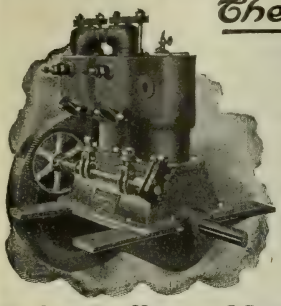
NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St., CHICAGO

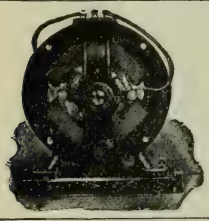


The Hoffman Motors

ANY HORSE POWER FOR ANY PURPOSE

Write for CATALOG . . AND . . PRICES

H. L. Hoffman Motor Company
28 West Randolph St., - - Chicago



Peerless Electric Co.

ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET

141-143 South Clinton Street
'Phone Main 1025 **Chicago**

Marine Engines

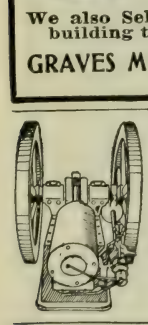
1 H. P.

Especially adapted to apply to boats 14 to 16 feet long, complete with reversible propeller. Batteries, carburator, spark coil plug and muffler. **Price only $65.00.**

Transmission Gears	**Bodies**
Sparking Plugs	**Spark Coils**
Contact Boxes	**Tanks**
Ignition Set	**Hoods**
Running Gears	**Pumps**
Carburators	**Oil Cups**
Pulley Rims	**Mufflers**
Motor Cycles	**Wheels**

We also Sell the Castings and Blue Prints for building these Motors. Price, $12.00 per set

GRAVES MOTOR MFG. CO., St. Paul, Minn.



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU
Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY
25 West Randolph Street, Chicago

ELECTRIC RAILWAYS
Dynamos : Motors : Gas Engines

Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,
262 E. Clifton Ave. Cincinnati, Ohio

A SKILLFUL ENGINEER.

During the digging of holes for New York telegraph poles not long ago the workmen noticed a mouse which had fallen into one of the cavities. For hours the tiny prisoner raced frantically around the enclosure. Then he seemed to get over his hysterics and set his wits to work. Soon he began systematically to dig a spiral groove, round and round the inner surface of the hole, which was several feet deep. Night and day the busy little captive worked away digging little pockets here and there as his improvised staircase got farther from the ground, so that he might rest from his hard labors. The workmen kept him supplied with food and after the third day the indefatigable little creature reached the top.

There are times when you wish to know the name and address of the manufacturer of some kind of machinery or appliance. Our information department is at your service. Enclose stamp for reply.

POPULAR MECHANICS PAID THIS MAN BETTER THAN ALL THE BLACKSMITH JOURNALS.

Mr. Toy, a copy of whose letter appears below, began using four lines in the classified columns of Popular Mechanics nearly two years ago. At first his order was for only one issue at a time. After eight issues he ordered two issues at a time; two months later he ordered four issues at a time; then in two months he largely increased the size of his ad., which has been running ever since. On February 8, 1904, while writing us about some other matters, he concludes his letter with the following interesting statement:

"Do you know there are more blacksmiths taking your magazine than they do the Blacksmith Journals? I am satisfied of this, as I get much better returns from my advertisement in Popular Mechanics than from the same ad. in any blacksmith journal. Recently a firm in New York wrote me asking if it paid to keep my advertisement in Popular Mechanics, and I told them it paid best of all."

W. M. TOY.

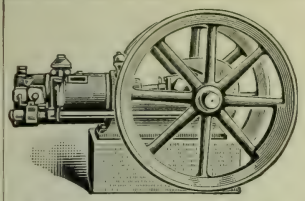
INVENTIONS VS. UNIONS.

A recent weekly issue of patents in the United States includes 575 patents and 49 trademarks. Of the patents granted, 91 were issued to residents of New York, 56 to residents of Pennsylvania, 52 to residents of Illinois and 32 to residents of Massachusetts. The number of patents granted on that date to citizens of foreign countries was 74, of which 20 went to Germany, 16 to England and 14 to France. Of the total number issued, there were sold in whole or in part 268 patents.

The number of patents granted is steadily increasing. One of the most potent causes of new inventions is the labor situation. Manufacturers are striving to obtain new labor-saving machines and devices. In the industries where the labor unions are strongest, is found the greatest progress in means for supplanting hand labor. This is the flood tide to the man with ideas.

A TRAGIC CALENDAR.

Jan-et was quite ill one day;
Feb-rile troubles came her way.
Mar-tyr like she lay in bed;
Apr-oned nurses softly sped.
"May-be," said the leech, judicial
"Jun-ket would be beneficial."
Ju-leps, too, though freely tried,
Aug-ured ill, for Janet died,
Sep-ulchre was sadly made.
Oct-aves pealed and prayers were said
Nov-ices with many a tear
Dec-orated Janet's bier.—Life.



"OTTO" means Economy in Gas and Gasoline Engines.

Fuel economy is due to correct design.

Economy in the use of fuel.

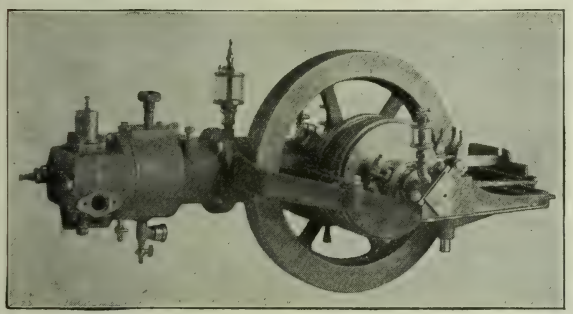
Economy in the cost of maintenance.

Economy in first cost because of great durability.

Slight cost of maintenance and great length of life are due to good materials and fine workmanship; cold facts that 75,000 users stand ready to vouch for and the logical results of 28 years of experience.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street MINNEAPOLIS: 318 3rd Street OMAHA: 1108 Farnum St.



ENGINES - -

Vertical and Horizontal

4 to 20 Horse-Power for

AUTOMOBILES

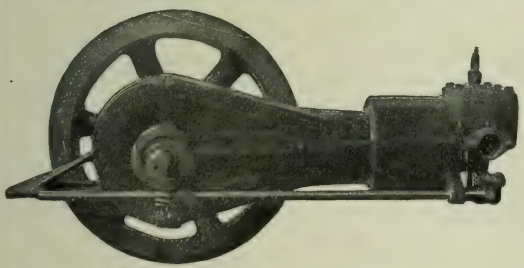
with and without Transmission

Send 3c. Stamp for Catalogue.

The P. J. Dasey Co.

Marine Building Chicago

WE BUILD THEM



THE MURRAY AUTOMOBILE MARINE and STATIONARY GASOLINE

ENGINES

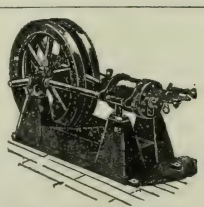
Transmission, Gears, Carburetters, Pumps, Mufflers, etc. : : : : : : :

Write for circular and prices before ordering

W. B. MURRAY, 1253 Milwaukee Ave., CHICAGO, ILL.

Dynamos and Motors

We have Dynamos from a special 8-light one up to 500 or more lights



From 1-8 H. P. up to 50 H. P., especially adapted for factory purposes

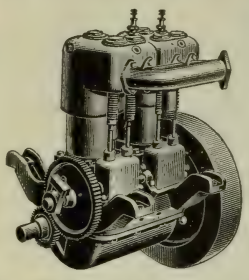
Gas and Gasoline Engines for Electric Lighting Plants, Farm, Factory and Shop. A cheap and safe power

Small Dynamo and **Motor Castings** and finished parts for complete construction. **Gas Engine Castings** from ¼ H. P. up.

We also carry a full line of Electrical Novelties and Experimental Apparatus. SEND FOR COMPLETE CATALOG.

L. W. GILLESPIE & CO., 218 E. 4th Street, MARION, INDIANA

DOUBLE CYLINDER



Gasoline MOTORS

4½ BORE. 5½ STROKE
12 H. P.
Simple—Reliable.

Write us for full particulars and prices

JACKSON MOTOR CO. 43 N. Union St., Chicago

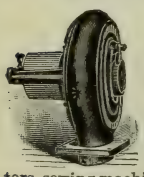
MOTORS

$5.00 Buys a
COMPLETE PRACTICAL BATTERY MOTOR—Not a Toy

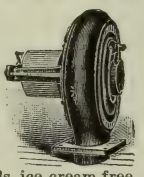
WALSH'S SONS & CO.
250 Washington St. - Newark, N. J.

WATER MOTORS

1-8 to 15 H. P.



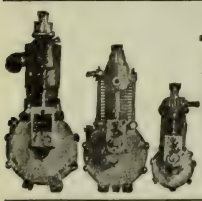
They are running most successfully printing presses, elevators, electric lights, machine shops, grist mills, planing mills, saws, laundries, shirt factories, air pumps, box factories, carriage works, meat cutters, church organs, ventilating fans, shoe factories, water pumps, feed cutters, sewing machines, coffee, spice and drug mills, ice cream freezers, jewelers' and dentists' tools in all sections of the United States and Canada.



If in need of power for any purpose and you are interested enough to write us we will consider it a pleasure to advise you. We want a live representative in every town to sell and install these motors.

☞ To hustlers we offer a first-class business proposition. Write now. Don't delay. First application gets it. Circulars free for the asking.

C. S. PIPER & CO. - - Detroit, Mich.



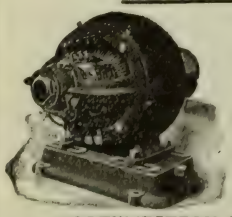
1 3-4 H. P. Bike Motor $7.50

Castings with Drawings 1904 Model

Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. Send for circular to

EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

Everything in Dynamos and Motors



1/20th UP

Write us for Particulars and Prices

NORTHWESTERN ELECTRIC COMPANY
69 West Washington Street, Chicago, U. S. A.

FROM TOIL TO FAME.

Written for Popular Mechanics by Geo. R. Harrison.

There's many a patient toiler
Who works for a higher life—
Who knows when he'll be the victor,
And rise from the irksome strife?
No matter how plain his person,
It houses a lofty soul;
A stout heart beats, and a great brain plans,
A way to reach the goal.

Perhaps where you hear the rumble
Of the giant wheels that turn,
Perhaps where you see the glowing
Of the furnace fires that burn,
There 'mid the din and the tumult,
In the dust, the grit and the grime,
A kingly man of a crowded world
Toils on and awaits his time.

Whenever he heats a rivet
And batters the fiery red,
The clang of the steel is singing
To him of success ahead;
Although there's a cloud o'er his visage,
His beaming smile comes through,
And his eye is bright with a future light
That will help the world anew.

As sure as the earth swings onward
Along its endless way,
As sure as the sun is shining
He'll climb to the top some day;
And the world will go to greet him,
And praise and cheer his name—
He'll reign supreme in a million hearts
And mount the throne of fame.

John D. Rockefeller is now said to control the United States Steel Corporation, the greatest industrial concern in the world, and Standard Oil methods will be employed in the management.

Fifty young women, daughters of wealthy parents, attending Rosemary Hall seminary at Rock Ridge, near Stamford, Conn., have set themselves the task of building a chapel. With their own hands they load the rock on the wagons, haul it to the building site and place the stones. The girls are acting as teamsters, loaders and receivers and have no male assistance.

Mr. H. E. Hanna:—Will you kindly send us your address? We lost it.—Editor Popular Mechanics.

Send for the Popular Mechanics new premium list.

When you want anything and don't know where to get it, write Popular Mechanics.

If your newsdealer does not have Popular Mechanics on sale regularly please let us know.

We are requested to announce that one of our readers has pleasant and profitable occupation, at remunerative salary, for several educated blind persons who are not otherwise physically incapaciated. Address "Blind," care Popular Mechanics.

A SUBSTITUTE WATCH CRYSTAL.

Did you ever smash your watch crystal just when you could not possibly replace it? When it happens again shake out the broken glass, open the little rim that holds it—the bezel—lay over the face a piece of tissue paper and shut the bezel. This will save the hands from catching in things and not interfere with the going.

The bulk of the paper used in China is made from the bamboo. The process of manufacture is as follows: The bamboo is placed in large vats in which caustic soda and chloride of lime are mixed with the water. The solution is allowed to soak until a scum rises to the surface. This scum is removed and is rolled into paper by hand process.

YOU CANNOT "MAKE BRICKS WITHOUT STRAW" BUT YOU CAN SECURE ANY OF THESE

High Grade Tools Without Money

The following carefully selected list of tools includes those which every mechanic needs, and which everyone who engages in mechanical work as a recreation will greatly desire to possess. We have selected a well-known brand, the excellence of which for quality and accuracy is beyond criticism. They are all from the celebrated works of the L. S. Starrett Company, manufacturers of fine mechanical tools. Every tool in these lists can be easily earned by securing a small club of new yearly subscribers to Popular Mechanics;

ANY TOOL IN THIS LIST FOR ONE NEW SUBSCRIBER

		Retail Price.
No. 303	4-in. Spring Tempered Rule	$ .45
No. 403	4-in. Beveled Edge Rule	.45
No. 330	4-in. Narrow Hook Rule	.45
No. 391	Spring Tempered Center Gage	.45
No. 450	Folding Pocket Rule in case	.50
No. 135	Nickel Plated Pocket Level	.50

ANY TOOL IN THIS LIST FOR TWO NEW SUBSCRIBERS

No. 303	Spring Tempered Rule, 9-in	1.00
No. 403	Beveled Edge Rule, 9 in	1.00
No. 420	Hook Rule, 6 in	1.00
No. 21	Thin Straight Try Square, 2 in.	1.00
No. 125	Adjustable Caliper Gage, 2½-in	1.00
No. 193	Protractor	1.00
No. 40	Screw Pitch Gage	1.00
No. 172	Thickness Gage	1.00
No. 87	Mercury Plumb Bob	1.00
No. 146	Adjustable Hack Saw Frame and Blade	1.00
No. 104	Speed Indicator	1.00
One Dozen No. 116 Asst. Nail Sets, in case		1.15

ANY TOOL IN THIS LIST FOR THREE NEW NAMES EACH

ANY TOOL IN LIST 1 AND LIST 2, OR,

No. 405	Patent Draftsman's Scale, 12 in	$1.50
No. 380	Steel Straight Edge, 18 in	1.80
No. 11	12-in. Combination Square	2.00
No. 60	6-in. Reliable Try Square	1.25
No. 425	Slide Caliper Rule, 3 in	2.00
No. 15	3-in. Universal Bevel	1.50
No. 6	Screw Pitch Gage	1.50
No. 36 or 37	6-in. Lock Joint Transfer Calipers	1.50
No. 186	Drill and Steel Wire Gage	1.50
No. 132	6-in. Level	1.50

TOOLS IN THIS LIST FOR FIVE NAMES EACH

ANY TOOL IN LIST 2 AND LIST 3, OR

No. 380	24-in. Straight Edge	$2.40
No. 510	Steel Tape in Leather Case, 50 in	4.00
No. 9	12-in. Combination Square Set	4.00
No. 33	Hardened Steel Combination Squares, Drop Forged	3.00
No. 20	4½-in. Hardened Edge Solid Steel Square	3.50
No. 25	4-in. Caliper Square with Adjustable Screw	4.00
No. 66	Locomotive Guide Liner	3.00
No. 57	New Universal Surface Gage, 12 in	3.00
No. 97	12-in. Improved Level for Testing Shafting	2.50
No. 197	12-in. Electrician's Level Non-Magnetic	3.50
No. 163	24-in. Draughtsmen's T. Square	3.50

TOOLS IN THIS LIST FOR TEN NAMES EACH

ANY TOOL IN LIST 1 AND LIST 5, OR,

No. 3	1-in. Micrometer in Case	$6.50
No. 113	1-in. Micrometer in Case	7.50
No. 2	2-in. Micrometer in Case	7.25
No. 124	B. Inside Micrometer	6.25
No. 360	Universal Bevel Protractor	5.75
No. 196	Universal Dial Test Indicator with Tool Post	7.50

Any tool in the Starrett Catalog desired, and not given above, will be given as a premium for a club. ∴ ∴ For particulars address

POPULAR MECHANICS : : Journal Building : : CHICAGO

MODELS & GEARS
CATALOGUES FREE
UNION MODEL WORKS
193 CLARK CHICAGO.

F. D. CROFOOT N. NIELSON
BLUE PRINTING BY ELECTRIC LIGHT
BLUE PRINTERS BLUE PRINTING, BLACK PRINTING, BLUE LINE & COLOR PRINTING
WRITE FOR PRICES.
CROFOOT, NEILSEN & CO.
167-169 E. Washington St. - - CHICAGO

MODELS
CHICAGO MODEL WORKS
179 E MADISON ST., CHICAGO, ILL.
ESTABLISHED 1867
WRITE FOR CATALOGUE OF MODEL SUPPLIES

MODELS AND SUPPLIES
WE MAKE
Working Models of Your Invention
After drawing or description, and charge moderate and fixed price for them. Experience, skill and modern equipped shop enables us to satisfy and assist you.
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Ave., Chicago

DIES, TOOLS, MODELS AND SPECIAL MACHINERY
Metal Specialties and Stampings Manufactured
HOEFT & MOORE, Chicago, U. S. A.
OFFICE: 85-87 Fifth Ave. WORKS: Indiana and Franklin Sts.

FOOT and POWER
AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::
SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

SPECIAL MANUFACTURING
Special MACHINERY-MODELS-EXPERIMENTAL WORK. DIES and STAMPING. Prompt. "Write for our booklet." The GLOBE MACH. & STAMPING CO.
970 Hamilton Street - - - Cleveland, Ohio

HINTS TO INVENTORS.

Foreign manufacturers of automobiles say there is a great field for a turbine engine for motor cars. The Motor News, Dublin, says: "The question of a gas turbine is a difficult one, and so far as can be seen is at present insoluble. On the other hand a report reaches us that a practical turbine motor is already nearly completed."

HOW TO THAW DYNAMITE.

To the Editor:—Please tell me (1) how to thaw dynamite; (2) does it lose its strength in time?

Answer:—(1) Dynamite should not be thawed by direct heat from a fire or stove. There is also more or less peril of producing leakiness and starting decomposition by thawing it in the sun. There is a peculiar peril from thawing it in the sun when the rays are transmtted through window glass, as imperfections in the glass are apt to focus the heat at certain points. There are only two safe ways to thaw dynamite, viz.: In a room heated by steam pipes, in which case the explosive must never be laid on the pipes; or in a vessel surrounded by warm water. The proper temperature of the water is 125 degrees F., which is approximately the temperature at which the bare hand can just be held without pain. The water should be heated separately and poured into the water space in the thawer, and the thawer should not be heated over a stove or other source of heat. The best material to use in making a thawer is sheet zinc, though the best grades of galvanized iron will do. All seams should be absolutely smooth, so as to leave no crevices for the lodgement of dirt and nitroglycerine. There are two forms of thawers made, one resembling a glue pot, or the farina boiler used in kitchens. The water space should be at least two inches wide between the inner vessel containing the dynamite and the outer wall of the vessel holding the water. In some, the water vessel has an additional space in the outer wall for an asbestos lining to conserve the heat. Dynamite is never properly thawed while it feels lumpy at any part of the cartridge. It should be uniformly pliable throughout. Its use when but partially thawed is attended with danger in loading, and its detonation will be imperfect, with the consequent disadvantages of yielding a less powerful effect and giving off noxious fumes. Good dynamite, if well stored, should retain its strength at least four years.

POPE PIUS MAY TRAVEL IN STATE.

Though the pope never travels, he owns a sleeping car which was constructed in 1868, when the line from Rome to Naples was opened. It will be exhibited at the Milan exhibition in 1905 to inaugurate the Simplon tunnel. There are three compartments—a throne room, a car for the guard of honor, and a bedroom. The throne room is richly furnished, and has a cupola engraved with the papal arms and the twelve apostles.

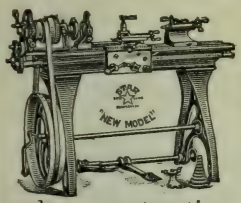
The carriage is so arranged that the pope, when seated on his throne, is plainly visible and can give his benediction to the crowds at the stations.

The sleeping car is divided into three parts—bed, bath and dressing rooms—which are hung with yellow and white, the papal colors. The bed is of ebony and ivory.

"Dreamland" will be Coney Island's newest attraction. It will occupy about three blocks and will be surmounted by a great illuminated tower 20 feet high. Brilliant electric displays, dance halls and innumerable other fascinations will be found in "Dreamland."

England had 63 war ships under construction January 1st of this year. Of this number only eight ships were being built in the Royal dockyards.

"STAR" FOOT AND POWER LATHES



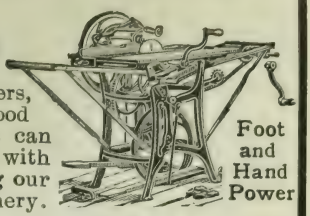
Are used extensively by repair shops, tool-makers, gun-smiths, experimental and model makers, etc.

Built for durable and fine accurate service, containing throughout the highest type of modern construction. 9 to 14 inch Swing.

SEND FOR CATALOG "B."

Wood Working Machinery

COMPLETE OUTFITS



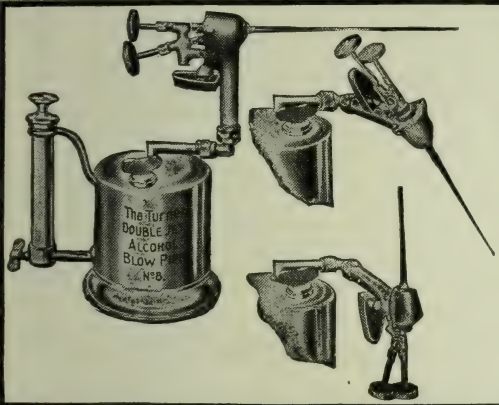
Foot and Hand Power

Carpenters, builders, cabinet-makers, wood workers and others can successfully compete with large shops by using our labor-saving machinery.

SEND FOR CATALOG "A."

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N.Y., U.S.A. Adv. No. 44.



Needle Flame

WITHOUT BELLOWS

The Turner Double Jet Alcohol Blow Pipe burns wood alcohol and produces a temperature of over 3000 degrees. Flame is non-oxidizing and adjustable up to 4 inches. Unexcelled for Jewelers' and Opticians' work, Soldering Fine Wires, Lead Burning, Etc.

Send for descriptive circular

The Turner Brass Works

55 N. FRANKLIN ST. - - CHICAGO

MACHINERY BARGAINS

SEND FOR MY PRINTED PRICE LIST OF

Automatic and Slide Valve Engines, Hoisting Engines, Boilers, Heaters, Air Compressors, Rock Drills, Crushers, Locomotives, Steam Shovels, Pile Drivers, Dump Cars, Dredge Machines, Traveling Derricks, Cableways, Concrete Mixers, Coal Mine Hoists and Machinery Generally. I handle both New and Second-hand.

WILLIS SHAW, - - - - 171 La Salle St., CHICAGO

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.

BOOKS SEND FOR OUR LIST OF LOW PRICES
Electrical and Mechanical Books
SPON & CHAMBERLAIN
Dept. P. M., Liberty Bldg., New York

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly.
$2.00 a Year
WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.

Agents Wanted
WEBSTER'S VEST POCKET PRONOUNCING DICTIONARY
Rules for spelling, etc. 194 pages, size 5⅛ x 2½ in. Full leather; gilt edges; indexed, sample postpaid, 25 cts. Will send free full particulars of Argument Settler, Writing Desk Book, Dictionary and other Vest Pocket Editions. For terms, address,
GEORGE W. NOBLE, Publisher,
602 Lakeside Bldg. Chicago.

Ready April 15th
Spangenberg's Steam and Electric Engineering.
Containing 1035 Questions and answers with 648 Illustrations. The best book ever published.
PRICE, $3.50
GEO. A. ZELLER, Publisher
19 South 4th St. - - - ST. LOUIS, MO.
Established 1870.

Electrical Books and Novelties
CATALOGUE FREE
Bubier's Popular Electrician, 50 cents per year; sample copy, 5 cents post paid; eight books 10 cents each. How to make a Dynamo, Motor, Electric Bell, Telegraph Instrument, Induction Coil, Telephone, Storage Battery, Talking Machine. Fully illustrated, TEN CENTS EACH. Dynamo and Motor Castings.
BUBIER PUBLISHING CO., Box P, Lynn, Mass.

3 Months Free
THE INVESTOR'S REVIEW
A journal of advice for everybody. Fully illustrated. Gives latest and most reliable information concerning industrial, mining, oil and other stocks and enterprises. No investor can afford to be without it. Keep posted. Knowledge is power. Fortunes have been lost for the want of knowledge of opportunities that came too late, and fortunes have been made by gaining knowledge easily obtained if you will only seek it. Great opportunities come and go. Great fakes likewise. Get posted before investing in anything. Write at once for *free sample copy.*
THE INVESTOR'S REVIEW,
1461 Gaff Bldg., Chicago, Ill.

THE VALUE OF A TRADE MARK.

By Foree Bain.

Almost every manufacturer is confronted with two problems. First, to produce his product; second, to dispose of it. Each of these propositions dominates a number of minor considerations peculiar to the business.

It costs many enterprises as much to dispose of their product as it does to produce it.

To create a steady and lasting demand, the article to be sold must have merit. The public must be made aware of its existence and impressed with its value. Advertising properly directed will accomplish this result. Sporadic announcements without any means for linking such attempts together, to produce cumulative results, is misdirected effort.

A trade mark is the rivet that binds the customer to the manufacturer, the chain that links advertising announcements together. It is a means by which advertising of the past is made available for the present.

A trade mark is a sign, symbol, mark, figure, picture, device, numeral, letter, word, name, or combination of any or all of them, used by a manufacturer, producer or vender of a commercial article, and indicating primarily either by its own meaning or by association, the origin, ownership, or place of manufacture, production or sale of the article to which it is applied. It is a notice to the public showing origin of the product to which it is applied. It must be clear and well defined.

A trade mark is inseparable from the business or good will with which it is associated. It must be exclusively the property of the proprietor or his jointly with others. It has been aptly defined as one's commercial signature.

Property in a trade mark comes from the common law and not from the statute. The registration of a trade mark is not a grant, but it is a prima facie evidence of ownership. The trade mark privilege is extended to persons engaged in promoting the commercial industries of the country, by the common law, to enhance and promote such industries and to protect the public against fraud and deceit.

The selection and adoption of a word, symbol, phrase, picture or other device for a trade mark requires careful, expert consideration. There are a great number of such devices that can not be legally and exclusively appropriated, and such a selection would be unfortunate.

Every manufacturer should adopt a trade mark, or several, if he desires, for the different classes of goods which he produces, and he should then have his mark properly registered.

SOURCES OF COLOR.

An interesting enumeration has been given of the sources of color. From this it appears that the cochineal insects furnish the gorgeous carmine, crimson, scarlet carmine and purple lakes; the octopus gives sepia—that is, the inky fluid which the creature discharges in order to render the water opaque when attacked; the Indian yellow comes from the camel; ivory chips produce the ivory black and bone black; the exquisite Prussian blue comes from fusing horses' hoofs and pigs' blood; blue black comes from the charcoal of the vine stock; Turkey red is made from the madder plant, which grows in Hindoostan; the yellow sap of the Siamese tree produces gamboge; raw sienna is the natural earth from the neighborhood of Sienna, Italy; raw umber is an earth found near Umbria; Indian ink is made from burned camphor; mastic is made from a gum of the mastic tree, which grows in the Grecian archipelago; bistre is the soot of wood ashes; very little ultramarine, obtained from the precious lapis lazuli, is found in the market.

Our New **FLASH BOILER**

For 1904

No burning of boiler—No water glass—No smoke. Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

Condensers, and other appliances are marvels of mechanical development.

See our exhibit at Chicago Automobile Show.

Barton Boiler Company

SOLE MANUFACTURERS,

4230 State St., Chicago, Ill., U. S. A.

WRITE FOR FULL PARTICULARS

BOOKS

MECHANICAL
ELECTRICAL
SCIENTIFIC
ETC. ℴ ETC.

We can supply you with any popular scientific book or any technical work.

SEND FOR CATALOGUE

A. C. McClurg & Co.

215-221 WABASH AVENUE

CHICAGO

Please Mention "Popular Mechanics."

X-RAY MACHINES

AND WIRELESS TELEGRAPH

APPARATUS $25.00 AND UP

X-Rays powerful enough to penetrate oak six inches thick

Will Show You Many Hidden Things

We build and design Static Machines and Induction Coils 3 to 24 inch sparks. We make Glass Plates, Leyden Jars, Etc., for Wimshurst Machines.

Send $1.00 for Circular A giving plans and directions how to build a small static machine giving 6 inch sparks.

N. O. NELSON & CO., Manufacturers of X-Ray Apparatus

171-173 EAST RANDOLPH STREET, CHICAGO ℴ ℴ

Engineering

Taught by CORRESPONDENCE

LEARN TO CONTROL THE WORLD-MOVING POWERS

FREE We will send free to your address our 80 page book (illustrated). Write for it at once. Our book is full of valuable information about how success is achieved and how our practical courses by correspondence accomplish astonishing results and give you the chance to rise to a higher position, salary and influence. What we have done for thousands we can do for you. All is done in your spare time without interfering with your present work. Thomas A. Edison and others indorse our Institute and our practical courses by mail in

Electrical Engineering, Mechanical Engineering, Steam Engineering, Mechanical Drawing, Telephony, Telegraphy, Electric Lighting, Electric Railways, Electric Motorman's Course, Mathematics, Short Electrical Course, Dynamo Tender's Course, X-Rays *Write for our book and state subject you are interested in*

The Electrical Engineer Institute of Correspondence Instruction, Dept. 6, 240-242 West 23d Street, New York.

ARITHMETIC

SELF TAUGHT

DO NOT DESPAIR because through neglect you have forgotten what you once learned about arithmetic Prof. Spangenberg's New Method requires no teacher.

194 pages. Price 50c.

Best Book Ever Published.

GEO. A. ZELLER, Publisher

Established 1870. 23 South 4th St., ST. LOUIS, MO.

Crescent Portable Lamp Guard

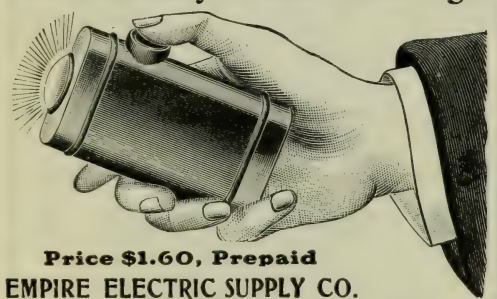
Useful
Ornamental
Durable

Price $1.50
Delivered
Anywhere $1.75

WRITE FOR PARTICULARS AND PRICES

Crescent Company
401 Omaha Bldg., Chicago

The Ever-Ready Pocket Flash Light



Price $1.60, Prepaid

EMPIRE ELECTRIC SUPPLY CO.
57 West Jackson Boulevard, . . CHICAGO, ILL

The World's Headquarters for
ELECTRIC NOVELTIES AND SUPPLIES

If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3 00
Battery Hanging Lamp	10.00
Telephone, complete, $2.50,	5.95
Electric Door Bells	1.00
Electric Carriage Lamps	5.00
Hylo Turn-Down Lamps	.60
$8 Medical Batteries	3.95
$12 Belt, with Suspensary	2.50
Telegraph Outfits	2.25
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights	3.00
Electric Railway	2.75
Pocket Flash Lights	1.50
Necktie Lights 75 cents to	3.00

SEND FOR FREE BOOK

$3 Electric Hand Lantern **Agents Wanted**

OHIO ELECTRIC WORKS . . . Cleveland, Ohio

ELECTRICAL BARGAINS

"Magic" Search Light (like cut)	$2.00
Vest-Pocket Light	1.50
Telephone, complete	2.50
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	90c. and up
Battery Motors	75c. to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Library Lamps	3.00
Electric Carriage Lamps	5.00
Electric Reading Lamps	5 00
Miniature Electric Railways	3.25
Electric Scarf-Pins	1.50

Our Free Catalog

describes many other electric novelties. We promptly refund money if dissatisfied.

AGENTS WANTED

These novelties sell on sight and are easily shown. Everybody is interested in some of them. We want good, live, responsible agents in every place, big or small, and there's an interesting proposition ready. All particulars for a postal.

J. W. SCRIBNER & CO., 161 Niagara St., Tonawanda, N.Y.

TYPELESS PRINTING MACHINE.

Newly Invented Machine Does Away With Type, Stereotypers and Matrix Makers.

A typeless printing machine, which the inventor claims will print as fast as a typewriter can operate, has been invented by W. S. Timis of Brooklyn. Mr. Timis believes that his new device will put an end to the use of type in all printing offices. Instead of type the machine makes indentures on a polished plate of metal from which the impression may be erased as readily as from a slate.

In its construction the machine utilizes to a certain extent the art of lithography, but it is equally akin to the typewriter and the piano. It does away with stereotypers and matrix makers, and comes as near to being automatic as a device can be. The operator seats himself at a keyboard resembling that of a typewriter. As his fingers touch the keys a strip of perforated paper, like a ticker tape, issues from the machine, and runs into another portion of the machine which operates automatically and grinds out proof of the matter printed as from regular type and in a continuous column. If errors have been made it is easy to correct the proof by pasting the correction over the erroneous composition.

Then comes the second process. The continuous column of printed matter is cut up to the lengths desired for the page of the newspaper or magazine it is to fill and pasted on a board made into sizes of the page desired. The printed surface is then pressed against a flat aluminum plate and the result is grease impression on the aluminum of every letter and character. The aluminum plate, which is as thin and light as cardboard, is then clamped on the cylinder of a printing press, the grease characters proving as distinct and durable as metal type.

IF YOU HAVE RHEUMATISM

and will write to the Magic Foot Draft Co., Courtland St., Jackson, Mich., mentioning this paper, they will send you a pair of their foot drafts, free on approval, to try. If you are satisfied with the benefit received from the drafts, you are expected to send one dollar to pay for them. If not, send nothing. You decide. This company claims to have cured many prominent people in every country on earth with their simple, cheap remedy. They all got the drafts without paying a cent in advance, and you can now do the same.

GIVES A CLEAR INSIGHT.

"Although but a recent subscriber to Popular Mechanics, I can say that I regard it a very valuable publication. It gives a clear insight into mechanical devices, and presents the subject in such a way that those who have little knowledge of such things cannot fail to understand."

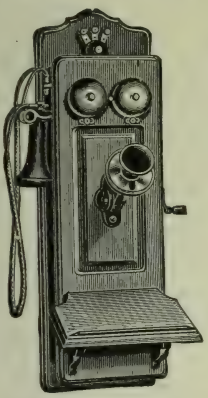
A. H. Brooklctmert.

Duluth, Minn.

HENDRICK'S COMMERCIAL REGISTER.

If you ever wanted anything and did not know who manufactured it or who to write to to get it, you will appreciate the value of Hendrick's Commercial Register, the most thorough and exhaustive work published, which is issued by the S. E. Hendrick Co., 76 Elm street, New York. The price of the work is $6. Every mechanical device, machine or piece of machine made is listed in this publication with the name of the firm that makes it. There is no manufacturer or buyer of any kind of material that can afford to be without the Commercial Register. Craftsmen of every description, the followers of every trade will find it just the thing they have been looking for. It enumerates every kind of trade, machinery and tool employed in every capacity. The thirteenth annual edition, now ready for delivery, is the crowning achievement of the worthy publication.

THE
QUESTION OF QUALITY
in
Telephones
is
Satisfactorily
Answered

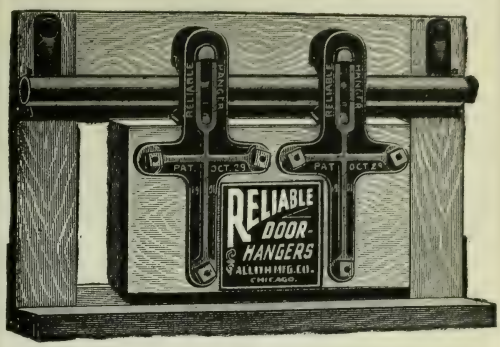


Our instruments are the best that long experience, skilled workmen and a complete equipment can produce. Our prices are the only cheap thing we offer. Let us send you a catalogue that tells all about the best Telephones for Rural Lines and Short Private Lines.

Acme Electric Co.

200 S. Clinton St. - Chicago, Ill.

The "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks.
Ours Will Not Bind.
Ours Cannot be Derailed.

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.
120 South Green Street
CHICAGO

The mechanical principles that have been proven best in all typewriters find concrete expression in the Standard

CHICAGO TYPEWRITER

$35.00

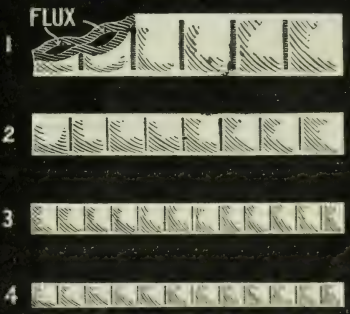
This almost human piece of mechanism exceeds the capacity of the most skilled fingers

CHICAGO WRITING MACHINE CO.
76 WENDELL STREET, - CHICAGO

KESTER Self-Fluxing SOLDER

Saves Labor--Time--Money

A TUBE OF SOLDER FILLED WITH FLUX



ACTUAL SIZE

PATENTED JULY 11, 1899
IN UNITED STATES, CANADA, ENGLAND
GERMANY AND FRANCE

Requires no Acid. Made With Various Fluxes
SEND FOR FREE SAMPLE

KESTER ELECTRIC MFG. CO.
253 So. Jefferson St., Chicago, Ill.

PATENTS

Skillful prosecution positively guaranteed. Rejected cases a specialty. Installments taken. Write for particulars. No charge for opinion as to patentability, etc. **$20.00**

THOS. A. HILL, Patent Attorney & Consulting Engineer
Main office: 261 Broadway, New York City
Skilled associates in Washington and abroad

PATENTS Protect Your Ideas

Consultation Free
Fee Dependent on Success
Established 1864
MILO B. STEVENS & CO.
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

A FREE BOOKLET FOR INVENTORS

Gives valuable information to those contemplating taking out American or Foreign Patents. It will save you money and time. Mailed free if you mention Popular Mechanics. Address

Robert Klotz & Co., Schiller Building., Chicago, Ill.

PATENTS promptly secured

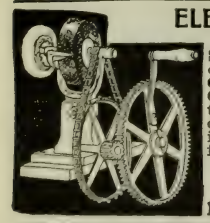
Trade Marks, Copyrights and Labels registered. Send photo sketch or model for FREE examinations as to patent ability. No fee till case allowed. Write

J. ALBERT WILLSON, Opp. Patent Office, WASHINGTON, D. C.

PATENT YOUR IDEAS

$100,000 offered for one invention; $8,500 for another. Book "How to Obtain a Patent" and "What to Invent" sent free. Send rough sketch for free report as to patentability. We advertise your patent for sale at our expense.

CHANDLEE & CHANDLEE, Patent Attorneys
918 F Street, Washington, D. C.



ELECTRIC DIAMOND GRINDER

Shipped on 10 days FREE TRIAL, 3,000 revolutions per minute. Only Hand Power Grinder with CARBORUNDUM wheels. Cuts eight times faster than emery, twenty times faster than sandstone. Will not draw temper. Try it FREE. If not satisfactory return at our expense. If satisfactory remit us $4.60.

LUTHER BROS.
Dept. P. M. North Milwaukee, Wis.

PLUMBING SUPPLIES

1-3 Saved by trading on our wholesale prices. Full line in stock. Quality guaranteed. Shipments prompt. Let us describe and quote prices on what you want.

B. P. KAROL, 231-235 W. Harrison St., CHICAGO, ILL.

For Mailing Lists, Addressing, Imitation Letters and all Circular Work, address

TRADE CIRCULAR ADDRESSING CO.
125 Clark Street, Chicago
Ask for 50 page Catalogue of Lists.

CURIOUS INVENTIONS.

Among recent inventions on which patents have been granted in the United States, we note the following, which are of more than passing interest:

A pack of playing cards having symbols and pictures, which are adapted for use in teaching geometry and which may be also used in connection with the study of astronomy. In addition to the geometric figures the cards contain pictures of ancient temples as well as modern structures and representations of the planets showing their relation to the solar system. The games for which these cards are adapted are most elaborate.

* * *

A citizen of California obtained a patent on an Anti-Snoring device, which consists of a mouthpiece formed of flexible material, in the center of which is a valve adapted to open in one direction. This device permits the user to inhale through his mouth, but requires him to exhale through the nasal passages. No provision is shown to prevent the sleeper swallowing the mouthpiece, but it is presumed the inventor has provided against accidents of that nature.

* * *

Mr. Charles A. Needham has patented an amusement device consisting of an elevated track on which is mounted a fully equipped sail boat, the latter being slidably secured to the track. Means are provided for holding the boat in a vertical position. The propelling power is dependent upon the wind and sails as in any other sail boat.

* * *

A citizen of Mississippi obtained a patent on a form of warranty deed, the novel feature claimed being the printing on the face of the deed of the representation of the town block in which the property conveyed is situated; also a diagram showing the relative location of the township in which such block is located. The holder of a deed is thus advised both by the description in the body of the deed and by the picture, of the exact location of the property conveyed.

* * *

A subject of King Edward, who resides at Clonskeajh, Ireland, has obtained a patent on a book case in which in addition to the usual shelves, which are made of greater depth than is customary, there are pivoted or swinging sections which open out like doors and are also adapted to hold books. The inventor claims by this arrangement he is able to accommodate two sets of small books on the same shelf, one set being in the rear and exposed to view only when the pivoted sections are swung open on their hinges.

* * *

The records of the patent office show a considerable increase in the number of patents issued on automatic stoking devices, some of which provide for over-head feeding and some for under-feed conditions. It is evident that the modern coal burning furnace is to be equipped with automatic stoking devices which will effect a gradual and constant feeding of the fuel thus avoiding the imperfect combustion which is incident to throwing in a large quantity of fresh fuel at one time. With the passing of the stoker the smoke nuisance will be almost entirely abated.

* * *

A significant feature of the recent patent reports is the increase in the number of United States patents taken out by citizens of foreign countries. In one week 93 patents were issued to foreign citizens, of which 30 went to England and 25 to Germany.

PATENTS

Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.

HARWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. patent office to enter this firm.

Address

210 Revenue Building - - WASHINGTON, D. C.

COOLEY COLT CALF AND COW WEANER

Position while eating

The Only Successful Weaner in the World

Guaranteed Not to Make the Nose Sore

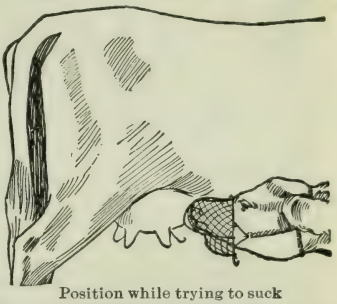
Guaranteed to keep any cow from milking herself, no matter how much she has been spoiled by other means, or whether she lies down or stands up.

GENERAL WIRE WORKERS

Inventions and patented articles in wire made to order or on royalty. We straighten and cut wire accurately from one inch up.

COOLEY & RANDEGGER MFG. CO.

103 South Canal Street, - Chicago, U. S. A.



Position while trying to suck

SPECIFY

CRANE VALVES

WRITE FOR POCKET CATALOGUE

NEW YORK
PHILADELPHIA
CINCINNATI
KANSAS CITY
SIOUX CITY
OMAHA

CRANE CO.

CHICAGO

ESTABLISHED 1855

ST. PAUL
ST. LOUIS
LOS ANGELES
SAN FRANCISCO
PORTLAND, ORE.

TROPICAL CUBA

Positively a Limited Opportunity

This is Worthy of Your Most Earnest Investigation

1,000 Shares non-assessable stock represent the entire capitalization of this Company, which is conducted on a strictly mutual basis and no stock given to promoters. **NO** salaried officers or directors. **NO** one can buy this stock cheaper than you.

SECURE AN ANNUITY FOR LIFE

One Share in a Few Years Will Pay at Least $1,500 Each Year

Write for Handsome Illustrated Prospectus Descriptive of Cuba

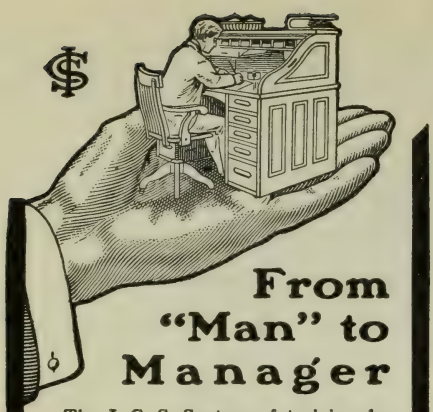
BUENAVENTURA PLANTATION CO.

Suite 1201, 159 LaSalle St., - - - - Chicago, U. S. A.

PLANTATIONS: BAHIA HONDA, NEAR HAVANA, CUBA

We refer by permission to EDMUND G. VAUGHAN, Vice-President National Bank of Cuba, Havana, Cuba, and Royal Trust Co., Chicago

Please mention Popular Mechanics when writing advertisers.



From "Man" to Manager

The I. C. S. System of training, by mail, is the helping hand by which many ambitious people have risen from the lowest to the highest positions in their craft or calling. Some have been enabled to change their occupation, taking positions in their chosen profession. What we have done for others we can do for you. Decide today to earn more money—then let us help you.

Write us, stating the position for which you wish to qualify.

Mechanical Engineer; Draftsman; Electrical Engineer; Electrician; Steam Engineer; Civil Engineer; Architect; Chemist; Ornamental Designer; Bookkeeper; Stenographer; Show-Card Writer; Ad Writer; Window Dresser; French, German, or Spanish, with Edison Phonograph; Commercial Law.

International Correspondence Schools
Box 872, Scranton, Pa.

PENMANSHIP PALMER METHOD TAUGHT BY MAIL

Learn a good business hand; it may be worth $5 every week in added salary at once and thousands of dollars in the future. Palmer Method is used today in hundreds of schools throughout the United States; teachers are sending work of over 100,000 pupils regularly to Cedar Rapids for individual personal criticism. We also teach penmanship at your home; copy of Palmer's Penmanship Budget (regular price $1) and complete 6 months' course of individual weekly criticism now $5. Diploma to graduates. Catalogue Free. (Established 1881.)

Palmer School, P. O Box 102, - Cedar Rapids, Ia.

TELEGRAPHY
Telegraphers' Penmanship and Typewriting
COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

BRIDGES, ELECTRIC AND STEAM RAILWAY FACTORIES AND POWER PLANTS

W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Cod

DRAWING STUDENTS NEED THE DRAFTSMAN
25c for 4 months—Cleveland, Ohio

TOO MUCH WHISTLE.

Once during the argument in a lawsuit, in which Lincoln represented one party, the lawyer on the other side was a good deal of a glib-talker, but not reckoned as deeply profound or much of a thinker. He would say anything to a jury which happened to enter his head. Lincoln, in his address to the jury, referring to this, said:

"My friend on the other side is all right, or would be all right, were it not for the peculiarity I am about to chronicle. His habit—of which you have witnessed a very painful specimen in his argument to you in this case—of reckless assertion and statements without grounds, need not be imputed to him as a moral fault, or as telling of a moral blemish. He can't help it. For reasons which, gentlemen of the jury, you and I have not the time to study here, as deplorable as they are surprising, the oratory of the gentleman completely suspends all action of his mind. The moment he begins to talk, his mental operations cease. I never knew of but one thing which compared with my friend in this particular. Back in the days when I performed my part as a keel boatman, I made the acquaintance of a trifling little steamboat which used to bustle and puff and wheeze about the Sangamon river. It had a five-foot boiler and seven-foot whistle and every time it whistled it stopped."

CAPPED SHOT FOR ARMOR TRIALS.

An important decision has been made by the English admiralty in connection with capped projectiles. In future all armor trials will be conducted with the capped shot, and as a sequel there has been manufactured for Woolwich arsenal machinery for the manufacture of caps for projectiles. They will thus be able to compete with private manufacturers, and the fact is a significant commentary on the oft-repeated assertion that progress is, as a rule, the result of private enterprise. In this case it is but fair to state that the adoption of the system is the result of many demonstrations of efficiency by the Vickers company. The cap, which is of relatively soft material as compared with shot, takes up the impact of the blow on armor, leaving the hardened point of the shot to do its most effective work on the plate. It has been proved time and again that capped shot successfully perforated Krupp armor when ordinary shot could not make much impression—the best being a penetration of three inches or so. Thus a 6-inch gun proved more than equal with capped shot to the 6-inch plate. For long it was doubted if perforation would result if the plate were struck when at any angle to the line of fire; but tests have shown that at any angle up to 30 degrees the results are similarly satisfactory. Then it was urged that while shot could do the damage, shell was not so victorious over the plate, and that, as something like 90 to 95 per cent of the projectiles carried by warships was shell, it was of no advantage to adopt this system. It could never be a disadvantage; but as a matter of fact shell has been fired from a 7.5-inch gun, containing the equivalent of a 6¾-lb. charge of high explosives, and this shell went through a 7-inch Krupp plate, lodging whole in the sand butts 300 yards beyond the target. It would have thus got through most ships' armor, and would have then exploded in the interior. This was with a comparatively low velocity; and it should be noted that perforation increases at a much greater ratio than velocity.

Permission of the war department has been sought for the power development of the Ohio River Falls. The proposed plant will develop between 100,000 and 200,000 horse power. The power will be utilized in the operation of manufactories and for developing the numerous traction interests centering near New Albany, Ind.

HOW TO MAKE

Electrical Instruments

Chapters of "Easy Electrical Experiments," which have been printed in Popular Mechanics as a serial, are for sale to close out all back numbers. All the chapters are complete, describing the instrument named in the list below. Sent postpaid on receipt of price.

Thousands of Popular Mechanics' readers have made these instruments from the descriptions which are given in plain, simple language, "written so you can understand it." Directions are fully illustrated. Money (or stamps) must accompany order.

TELLS HOW TO MAKE

No.	Parts.	Cents.
1—Simple Galvanometer	1	5
2—Box to Hold Battery	1	5
3—Tangent Galvanometer	1	5
4—Powerful Magnet	1	5
5 Electric Circuit of Water	1	5
8—Measurement of Resistance	3	10
9—An Electrophorus	1	5
10—Electric Condenser	1	5
11—Laboratory Storage Battery	3	10
12—Rheostat	3	10
13—Electric Bell	3	10
14—Electric Plating at Home	3	10
15—Small Dynamo	5	20
16—Electric Engine	1	5
17—Electric Gyroscope	3	10
18—Electric Locomotive	1	5
19—Model Fire Alarm Telegraph	2	10
20—Electric Bomb	1	5
21—Automatic Circuit Closer	1	5
22—Electrically Lighted Lamp	1	5
23—Simple Arc Lamp	1	5
24—Experimental Battery	1	5
25—Portable Voltmeter	3	10
26—Large Induction Coil	4	15
27—Sensitive Galvanometer	1	5

ORDER BY NUMBER

Address

POPULAR MECHANICS, Journal Bldg., CHICAGO

NOTICE---SALESMEN

We would like to secure a few more high-class salesmen to sell plantation stock in a strong company, offering a proposition superior to others and a ready seller. To such men we offer a most liberal contract that will enable them to make from $200 to $500 per month. No other than high-class men desired. Write for particulars at once. All communications confidential.

AMERICAN TROPICAL PLANTERS CO.
84 ADAMS ST., CHICAGO,

BIG PAYING BUSINESS
FOR MEN AND WOMEN.

Write for names of hundreds of delighted customers. Make $30 to $50 weekly. Do business at home or traveling, all or spare time, selling Gray outfits and doing genuine gold, silver, nickle and metal plating on Watches, Jewelry, Tableware, Bicycles, all metal goods. Heavy plate. **No experience,** quickly learned. Enormous demand. **No toys or humbug.** Outfits all sizes. **Everything guaranteed. Let us start you. We teach you FREE.** Write today. Address,

H. GRAY & CO., Cincinnati, Ohio.

REMINGTON TYPEWRITERS $25

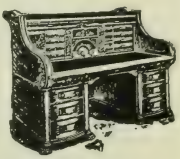
All Other Makes at Proportionately Low Prices.

Large Assortment, Bed Rock Prices.

The W. B. MORRISON CO.
(Incorporated)
119 LaSalle Street, Chicago

IT HELPS BUSINESS

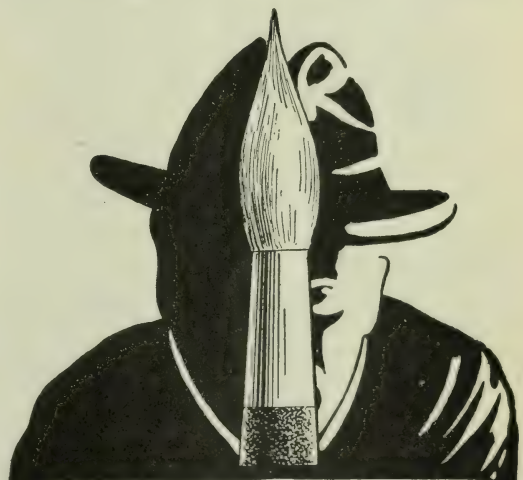
To Have Your Office Furnished With



ANDREWS' HighGrade Office Fittings
ANDREWS Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs

Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.
174 Wabash Ave., - - Chicago



THE MAN BEHIND THE BRUSH

If your Ad. is not bringing in the best returns **Let Me Know.** If your Zinc or Half-Tone Engravings do no Sell your goods fast enough **Let Me Know.** My cuts will sell your goods no matter what they are.

I AM THE MAN BEHIND THE BRUSH

Before placing your next order **Let Me Know.**

C. G. BROWN, Commercial Artist
160 Washington Street, - - Chicago
Telephone Main 3376

MAGIC

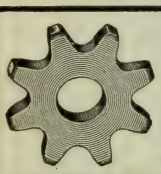
I will teach you one new coin trick and one new card trick for 20 cents, or either for 10 cents. I will send *"Book of Card or Coin Tricks,"* 180 p., 25c. each, and include illus. catalog of 240 tricks free with order. Learn at home, amaze your friends, mystify, start e and entertain. ROBERT WASSMANN, Instructor in Magic, 227-z Webster Ave,, CHICAGO, ILLINOIS.

J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing. Lithographing
165-167 Dearborn St. Chicago

CHURCH CROSSES

WEATHER VANES
COPPER LIGHTNING RODS
TOWER ORNAMENTS
COPPER FINIALS, etc.

80 page Illustrated Catalogue mailed free
T. W. JONES, Mfr., 18 Fletcher St., N. Y. Est. 1862



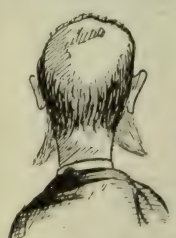
SPROCKETS
and EQUALIZING GEAR
IN STOCK OR TO ORDER. Agent for Baldwin Diamond Duckworth and Whitney Chains. CATALOG FREE.
CULLMAN WHEEL CO., 521-525 Larrabee St., Chicago

BRASS BAND
Instruments, Drums, Uniforms. Lyon & Healy "Own-Make" Instruments are preferred by Thomas Orchestra, Banda Rossa, Mascagni, etc. Lowest prices. Big Catalog; 1000 illustrations; *mailed free;* it gives instructions for amateur bands.
LYON & HEALY, 2 Adams St., Chicago

Every Bicycle a Motor Cycle

by using one of our ATTACHABLE MOTOR outfits. Thoroughly practical. Can be applied to any wheel. On the market four years. Also Motors and Castings for Bicycle, Automobile, Marine or Stationary.
LOWEST PRICES. 2-cent stamp gets our catalogue.
STEFFEY MFG. CO., Brown & Pennock Sts., Philad'a, Pa.

I Positively Cure



Sparking, Humming, Cutting, etc., of Commutators and Brushes

Write me, giving full description of your trouble, style of machine, load carried, and I will send you treatise on same

FREE OF CHARGE

J. S. HART, M. D. & D. D., - Monadnock Building, Chicago
(Doctor of Motors and Dynamos)

CHICAGO AUTOMOBILE SHOW.

The automobile show which closed at the Coliseum, Chicago, Feb. 13, was the most representative American exhibition of the kind ever held. More than $4,000,000 worth of machines were sold during the week of the exhibition; 100,000 persons passed through the gates, and all the famous manufacturers of America, excepting one, were represented. The American make of machine ruled in the exhibit and they went far to demonstrate the great improvements in their construction that have been made in recent years. There were 3,500 cars sold during the exhibition to persons living in all parts of America, from Boston to San Francisco. The motor cycle also came in for a large amount fo attention.

Among the exhibits of accessories attracting much attention were those of the Hoffman Motor Co., of Chicago, who had one of the best displays of gasoline engines at the show; the Turner Brass Works, of Chicago; and the Kaestner Mfg. Co., of South Bend, Ind.

A. M. Rothschild & Co."s exhibit of Cleveland automobiles also attracted much attention. These automobiles Rothschild & Co. sell on the installment plan, being the pioneer firm to bring a really high class automobile within the reach of all. During the week's show at the Coliseum they took orders for thirty-one machines—on installment orders.

The exhibit of motor cycles was unusually fine. Among the displays that attracted especial attention were those of the

Wagner Cycle Co., of St. Paul, Minn.; Pope Manufacturing Co., of Hartford, Conn.; Hendee Mfg. Co., of Springfield, Mass., exhibiting the Indian Motor Cycle; A. M. Rothschild & Co., Chicago, exhibiting the Orient Motor Bicycles and the Whipple Autocycle; Mitchell Motor Cycle Co., of Racine, Wis., and Thomas Co., of Buffalo, N. Y.

Among the exhibits of automobiles was the beautiful green and white car of the Fredonia Mfg. Co., of Youngstown, O. This was one of the handsomest cars at the show and said to have been declared the finest at the New York automobile show. It was in a Fredonia car, by the way, that Mr. Thomas of the Fredonia Mfg. Co., made the wonderful endurance run described in Popular Mechanics for February.

BOOK REVIEWS.

MODERN WIRING DIAGRAMS, pocket size, 4 by 6 in., bound in soft leather, 160 pp., 200 illus. Price, $1.50. (Given for 3 new yearly subscribers to Popular Mechanics.) This is unquestionably the most useful and practical work on this subject ever printed. It is written by two men who have had years of experience installing the work described in this book. It tells you just "how to do things," and illustrates what it tells with all the diagrams necessary. Explains how to locate trouble and how to cure it. It is not a text book, it does not deal in theories, but is emphatically a book for workers. The following suggests the character of the work: This book tells how to wire for call and alarm bells, for burglar and fire alarm, how to run bells from dynamo current, how to install and manage batteries, how to test batteries, how to test circuits, how to wire for annunciators, for telegraph and gas lighting, it tells how to locate "trouble" and "ring out" circuits, it tells about meters and transformers, it contains 30 diagrams of electric lighting circuits alone, it explains dynamos and motors, alternating and direct current, it gives ten diagrams of ground detectors alone, it gives "compensator" and storage battery installation, it gives simple and explicit explanation of the "Wheatstone bridge" and its uses as well as volt-meter and other testing, it gives a new and simple wiring table covering all voltages and all losses or distances, etc., etc.

The Illinois Central Railroad proposes to emulate the example of the New York Central and electrify its terminal and suburban lines in and near Chicago.

Popular Mechanics

Vol. 6. No. 4. CHICAGO, APRIL, 1904. 10 Cents a copy. $1.00 a year.

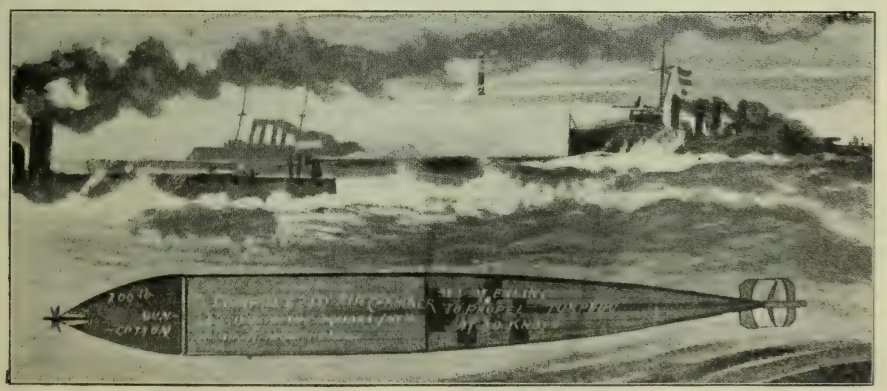
The Torpedo--War's Deadliest Weapon

One of the World's Most Ingenious Mechanisms--Description of Its Construction and Operation

"At its nose a small metal pin. Behind the small metal pin a little fulminate of mercury. Behind the fulminate of mercury a wisp of dry guncotton. Behind the wisp of dry guncotton a mass of wet guncotton. Behind the wet guncotton a braced chamber nearly bursting with compressed air. Behind the compressed air a set of panting cylinders. Behind everything a set of excited double-bladed screws. The whole little water mole burrowing through the waves at the rate of 30 knots an hour. The dark, stupendous interposing bulk of a battleship. A sudden jar. The small metal pin nudges the fulminate of mercury. The fulminate of mercury whispers to the guncotton. An explosion and an upheaval."

This is the torpedo and its mission, as has been told, in a nutshell. When the explosion comes it is all over with the battleship. The little mechanical "water mole" has worked the complete destruction of its giant object of attack. A great hole has rent the warship's hull. The vessel reels, tips, screaks; the sailors and crew amid pandemonium and death wrought by the bursting of the oblong submarine shell, struggle wildly for the lifeboats; the ship gives a sudden lunge and down toward the bottom it goes. Above it curls the whirlpool, and then, on the water calming, is the debris of the wreck and those that are not dead still struggling for life.

This is the work of the torpedo and its life's mission is done. It is the deadliest, most stealthful, most ingenious instrument of war. It has been declared to display the



A Torpedo in Flight--Sectional View Showing Interior

most wonderful mechanical ingenuity of any machine ever constructed by man. The torpedo is so built that when fired it cannot swerve or deviate from an absolutely straight course and the most powerful ship the world has ever built is as surely doomed as it is struck by a Whitehead torpedo.

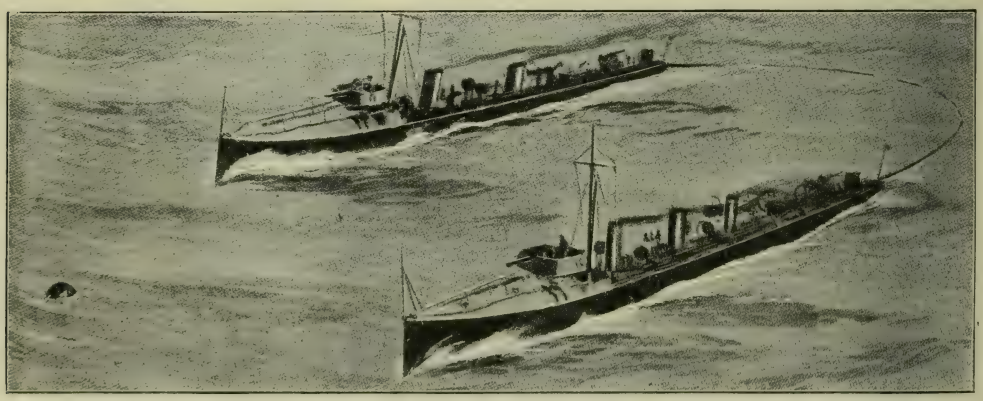
Deadly, powerful and ingenious as they are, the use of torpedoes is so far restricted, because of the perils necessarily encountered in using them. The torpedo boat, from which they are generally fired, is the frailest of craft, a rifle shot being sufficient to sink most of them. England, however, has lately produced some remarkably substantial torpedo boats. They have proven themselves seaworthy in a gale, a feat never accomplished before. Next to England the United States has the most substantial of the boats, several of which have been described in Popular Mechanics. Japan's torpedo boats and torpedoes were built in England and represent a high efficiency of workmanship, but not England's best.

The net is the only protection against the attack of torpedoes and they, until recent trials before the Prince of Wales at Portsmouth, England, have proved very unsuccessful. In the mimic battle in which submarines and battleships participated, a submarine torpedo boat was captured in a net by battleship picket boats. The ingenious expedient by which the boat was literally picked up out of the water was the conception of Admiral Wilson. The officers on the picket boats attached to one of the nets saw a periscope moving on the face of the water and they maneuvered so as to make the net bar its progress. A few moments later a straining at the hawser told them that they had stopped the progress of the submarine. Immediately the boat altered its course so as completely to envelope the unfortunate under-water craft in the net.

The poor little vessel found itself in the toils and as the hawser had carried away the periscope, the sole means of seeing what was happening on the surface, the crew could do nothing but await developments. The submarine was raised to the surface and the crew had the most startling experience of record. The officers will not soon forget how they were caught like fish in a cleverly planned steel sieve.

The torpedo is successful only when there can be found men ready to sacrifice their lives in operating it. The chances are about even that they who start out to torpedo a vessel will never return alive. No insurance company will take the risk of insuring their lives.

By seamen the torpedo is called the "baby." It is shaped like a cigar and is from 14 to 18 inches in diameter at the thickest part, and from 14 to 20 feet long. The latest and largest size weighs 1,150 pounds and has a speed of 32 knots for 2,000 yards. The 14-inch or smaller projectile has a speed of 30 knots for 2,000 yards and weighs 706 pounds.



Destroyers Capturing a Submarine in a Net, Guided by the Submarine's Periscope, Which, as Seen in the Picture, Looks Like a Ball Floating on the Water

The torpedo is the most wonderful of all projectiles, if it may be called a projectile. It is a self-propelled, self-steering, self-operating mechanical projectile, that once fired, performs its duty of death with

Japanese Firing Torpedoes at Russian War Vessels Off Port Arthur

almost human skill. It is a kind of automatic submarine boat, built at a cost of $3,000, for a single trip on which depends its success or failure. It is built with utmost pains and carefully kept until the time for it to start on its one and final errand of destruction and give it's puny life for the life of a ship. Thus the torpedo is the costliest as well as the most formidable projectile of war. The torpedo boat, as its name implies, is the craft generally intrusted with the firing of torpedoes, although they are made part of the munition of all warships. Their success in the latter capacity, however, has never been satisfactorily demonstrated. There are several makes of the projectile, the most successful of which is the Whitehead, named for its inventor, a mechanic of Fiume, Hungary, where the largest torpedo factory is now located. Torpedoes for the American navy are built at Brooklyn, under a license from the patentees. There are factories in England and Germany.

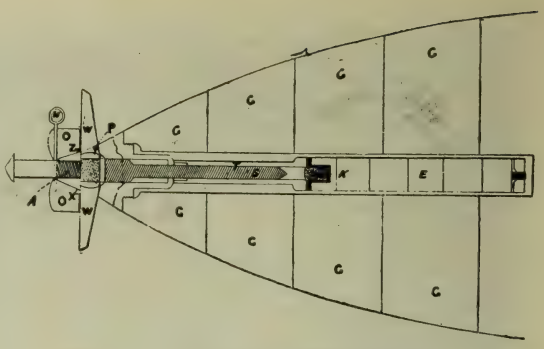
Torpedoes are fired from torpedo tubes, above and below water, generally above. The torpedo after striking the water, sinks itself slightly below the surface and then proceeds on a bee line for the object at which it was fired.

The form of tube now being issued to the navy for broadside firing is about 30 feet long. The lower section of the forward half is cut away, leaving a long overhanging spoon sticking out. Inside the cylinder, on the top, is a T slot, extending from the breech to the end of the spoon. In this T slot fits a small T projection on the top of the torpedo. Suspended by this projection the torpedo balances, so as it is sent out of the tube the T carries it out to the tip of the spoon in a horizontal position, and, slipping out of the slot, the torpedo strikes the water nearly level. Without the suspension arrangements the nose of the torpedo would dive down as it slipped over the forward edge of the tube, resulting in a deep initial dive.

The torpedo is blown out of the tube, either by compressed air, suddenly injected into the rear end, or by an impulse charge of a few ounces of powder. When the projectile strikes the water, the resistance starts a fan, near the front end of the striker, to revolving on a screw thread. When the torpedo has gone 14 yards this fan has run off the thread and drops, leaving the striker unhooded and unhindered in firing the charge of guncotton behind it when it strikes the hull of the battleship. The engines in the torpedo have started to running at full speed as soon as it enters

The foremost compartment of all in a torpedo is that containing the charge and the pistol with which it is fired. In fitting the warhead with the firing apparatus, the pistol and primer charge is inserted into its foremost end, all in one piece and screwed in tight. The body of the pistol and the striker tube are made of bronze, and the striker itself is made of nickel plated steel. The explosive head of a torpedo is shown in the diagram. A short distance from the foremost end of the striker is a fan, O, revolving on a screw thread, A. Just abaft this screw thread is another one on which the whiskers, W, are screwed tight. The fan, O, before the torpedo is fired bears up against the whiskers, W, but not too tightly and to prevent its being metal bound against it, a hole, X, is cut in the corner of three of the whiskers, while the fourth is kept closed and bears against a stud, Z. This prevents the fan from being tightened up too much and leaves it free to revolve, for the holes in the three other whiskers enable them to revolve past the stud and by the time the fourth whisker is up to it again, it will have screwed forward to pass. The detonating charge, K, is 38 grains of fulminate of mercury, and the primer charge, E, consists of six 1-ounce discs of dry guncotton contained in a copper cylinder, the foremost end of which, as will be seen, is fixed on the striker tube or the pistol. The rear end of the cylinder is kept tight by an India rubber ring. When the torpedo strikes a rigid object the striker, S, is driven in against the detonator, K, which detonates the primer, E, which in its turn detonates the guncotton charges, G.

It would not do to allow the striker to lie at the mercy of any chance blow against its outer end. So three checks are provided against such a contingency. In the first place the striker cannot go back until the little fan, O, has revolved off it. When the torpedo enters the water the fan begins to revolve and travels away from the whiskers until it has run off the screw thread, A. The torpedo runs 40 feet before it has done this. Even then the striker is not in working order unless the blow is a very heavy one, for a little copper pin, P, is standing in the way. Unless the blow is heavy enough to shear this pin, the striker cannot



Torpedo Warhead

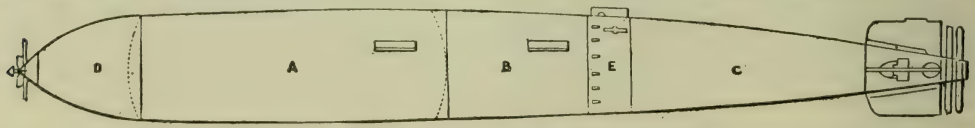
be driven back. The shearing pin acts as a guard until the actual blow takes place. Then there is a third precaution in the shape of the safety pin, M, which holds the fan, O, fixed until it is withdrawn at the last moment as the torpedo is launched into the tube. When all is ready for firing a torpedo ,the safety pin, M, is removed. As the torpedo rushes through the water, the fan, O, begins to revolve until on reaching a distance of 14 yards when it has run off the screw thread—and the striker is no longer hindered by it. Then when the torpedo strikes the object the striker is driven violently inwards, the pin, P, is sheared and the point of the striker is driven against the detonator, K, and the torpedo explodes.

The head of a torpedo is packed with slabs of guncotton about 1½ inches thick, cut into quadrants, and 17 per cent of added water, besides being very carefully placed so as to fit closely around the primer canister. The guncotton charge is kept permanently stowed in the warhead, the shell of which is made of phosphor-bronze 1-16 inch thick, the pistol socket and the base-ring being firmly screwed to the shell by screw rivets, and the joint is afterward carefully soldered to prevent leakage.

---

the water and all its wonderful machinery is now in full operation. The engines, run by compressed air, revolve the propeller screw and give the projectile its speed. On striking any hard object, the striker, which performs the office of the hammer of a revolver, is driven back violently, exploding a fulminate of mercury cap, then the dry and then the wet guncotton. There is a great

finest forged steel or of phosphor bronze, and is divided into several sections. The first section is the firing arrangement. The next is the explosive chamber, in which the guncotton is kept. Then comes the air chamber. The fourth section is the "balance" chamber; the fifth the engine chamber; sixth the buoyancy chamber; seventh the level wheel chamber; eighth the hori-



Latest Type Whitehead Torpedo

A.—Air Chamber. B.—Balance Chamber. C.—Buoyancy Chamber. D.—Explosive Head. E.—Engine Room.

upheaval. The torpedo is no more and the battleship is wrecked.

It is the guncotton that causes the awful destructiveness of the torpedo when it explodes. There are 220 pounds of wet guncotton contained in the warhead, the foremost of the several compartments of the projectile. Into this wet guncotton runs a primer of dry guncotton, which is ignited by the striker striking the fulminate of mercury cap as described.

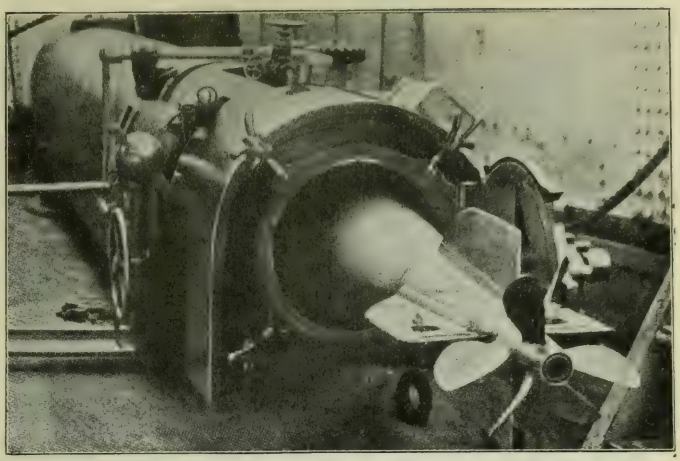
The Whitehead torpedo is made of the

zontal and vertical rudders and propellers. The several sections are separated by bronze bulkheads.

Compressed air is the motive power. This is contained in the air chamber, or air flask. On shipboard this flask is filled with an air-compressing engine and the pressure attained is 1,350 pounds to the square inch. The flask is tested for a pressure of 2,000 pounds. The air is so compressed that the weight of the ten cubic feet in the flask is 69.19 pounds. A pipe connects the flask

with the torpedo engine room, a small compartment in the forward part of the afterbody.

The engine consists of three cylinders, radiating out from the propeller shaft like a three-leaf clover. The cylinders could be carried in a man's overcoat pocket, but they often have a combined power of 56 horsepower. A main crank, turning the propeller shaft, receives its impulse from the piston of each cylinder in succession. Three slide valves on each cylinder regulate the admission of air. The propeller shafts turn two double-bladed screws in the tail in opposite directions, a gearing in the afterbody giving the reverse motion to one propeller. The two propellers neutralize their individual tendencies to cause the torpedo to roll. To secure the right balance between them the propellers are shaved down after experimental runs.



A Torpedo in Its Tube Showing the Double Propellers

In the balance chamber is located the automatic apparatus which, by means of four rudders, keeps the torpedo in an exactly direct course during its flight and at a proper depth in the water. The buoyancy chamber lies next abaft the engine compartment. The engines are shut off from this chamber by the bulkhead with which they are secured. The chamber contains the necessary apparatus to give buoyancy to the projectile. To insure the torpedo's being always in a perfectly upright position, a certain amount of ballast is kept stowed in the bottom of the chamber.

If the torpedo from any cause be deflected out of the line of fire, the gyroscope, by maintaining its axial position in the line of fire, acts on the servo-motor and by means of the vertical rudders steers the torpedo back again into its original direction.

The hindmost compartment is called the tail. It forms a continuance of the buoyancy chamber and contains the wheel gearing for turning the propellers in opposite directions; the upper and lower perpendicular fins, and the frame holding two horizontal rudders; the vertical rudders and gyroscope vertical rudders; the horizontal rudders and the propellers.

The earlier torpedoes were not cigar-shaped as at present, but had fine tapering heads, the contention being that such shape offered least resistance and assured greater speed. The present form of the projectile was suggested by the shape of the fish, and just why it offers least resistance and gives greater speed is not understood but the fact remains that it does. All the fastest swimming fish are blunt headed and taper away to the tail.

The improved torpedoes can be fired from the fastest ships, while going at full speed, with absolute accuracy of aim, no matter what the bearings or speed of the enemy.

The United States is the birthplace of the torpedo. It was during the Civil War, when

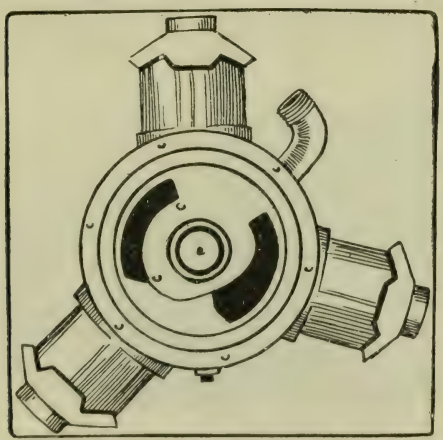
A Submerged Torpedo Tube on Board the Battleship "Peresviet" Now at Port Arthur

Americans opposed Americans, and when "war that was war" raged, that numerous new ideas were brought forth by inventors,

Russian Soldiers Embarking Torpedoes on the "Czarevitch" Eight Hours Before the Commencement of Hostilities

revising the whole practice of naval battles. The ironclad, the turret and the torpedo and the submarine mine were some of the things that grew out of that titanic struggle.

It remained for European countries to develop the torpedo to its present state of



Compressed Air Engine Used in Torpedo

efficiency, however. The Whitehead torpedo factory at Fiume, Hungary, is now managed by an Englishman named A. E. Jones. This company was founded in 1858. It now employs 700 skilled workmen and can turn out two complete torpedoes daily. The employes are nearly all Croatians.

Besides the Whitehead, there are other makes of torpedoes, among which might be mentioned the Spar, which was the original American torpedo and which did great damage during the Civil War; the Brennan; the Howell; the Schwartzkopff; the Peck, an automobile torpedo; the Sims-Edison; the Maxim, a locomotive torpedo; the Lay and Nordenfeldt (automobile torpedo).

AN ELECTRIC TOWER CRANE.

A remarkable electric tower crane for use in constructing tall buildings has been built in Germany.

A tall tower of structural iron, mounted on wheels and capable of moving along a track at the rate of 130 feet per minute supports a steel mast from which projects the boom, the distance from the center of the mast to the hook being nineteen and

Electric Tower Crane.

one-half feet. A single man can control the crane from the lower platform by the use of three motors, one for moving upon the track, one for revolving the mast and one for lifting the load. Loads can be lifted eighty-two and one-half feet.

The Electrical Review says: "The crane can lift ten tons with a velocity of sixteen feet per minute, and three tons or less with a velocity of fifty-seven feet per minute."

Mechanical Hen Hatches 300 Chickens Daily

World's Largest Incubator Holds 7,500 Eggs---Is Heated by Hot Water

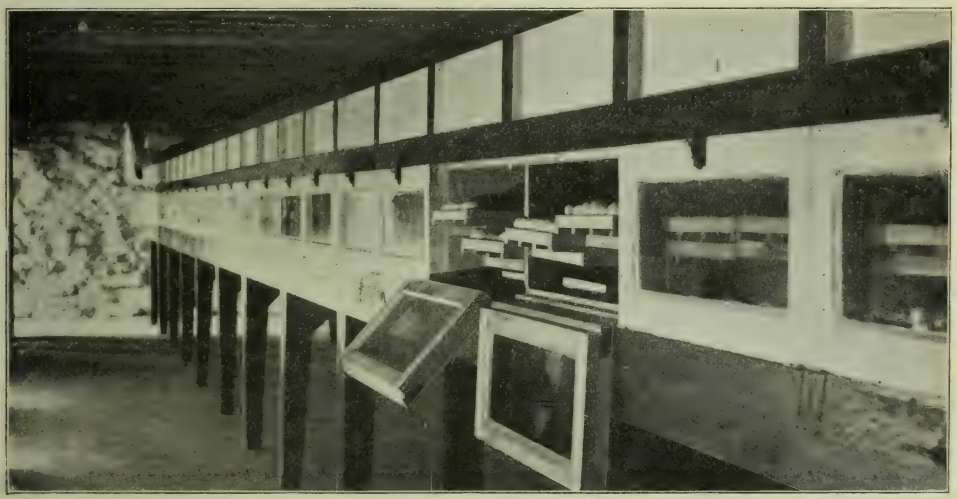
Nearly three hundred young chickens springing into life every day from a giant machine that does the work of 3,500 hens —this is the performance of a single incubator, the largest chicken factory in the world. The machine is at Ransomville, New York, and is the property of Mr. W. R. Curtiss.

This great mechanical hatchery holds 7,500 eggs, and if all of them were to hatch it would mean 7,500 chicks every three weeks, or more than 370 a day, but of course, allowance must be made for eggs that do not hatch. There are 50 compartments in the incubator, each 24 inches square and each holding two trays of 75 eggs each. The incubator is 51 feet long, and 4 feet 4 inches wide.

The inventor of this remarkable incubator is W. P. Hall, of Pembrooke, N. Y. The mammoth machine is heated by a hot water system, the jacket stove being located at one end. Over the top of the incubator 16 pipes, each 1¼ inches in diameter, are run, and these heat the compartments. Over the heater there is an expansion tank, 10 by 18 inches, made of galvanized iron. This tank is filled with oil, in which a float operates. As the heat increases the water in the pipes expands and causes the float to rise This operates a throttle attachment on the float arm and shuts off the draft of the stove, while at the same time another lever opens the cold air draft. This renders it quite impossible to overheat the eggs. The arrangement is exceedingly sensitive.

The heat of the pipes is kept at a steady temperature of about 103 degrees, but as the hatch advances and the eggs develop into chicks there is quite a little animal heat given off by the fertile eggs. This increases the temperature in the compartments, and recognizing the fact the patentee of the incubator has arranged to set the egg trays on a wooden adjuster that can be lowered at various stages to the bottom of the compartment. The open doors of the incubator shown in the picture illustrate clearly the different heights at which the trays can be set. The first drop is made in about six days. In the bottom of the adjuster frame there is a pin designed to set in a series of holes in the bottom of the compartment. As the adjuster frame is hinged as this pin is set forward in the holes, it has the effect of lowering the tray. Each compartment door has a double glass 7 by 20 inches in size, affording a full view of the compartment interior.

It is startling to consider what can be done with such a machine during the normal hatching period, not to speak of the



Copyright 1903 by C. E. Dunlap.

The World's Largest Incubator

fact that it can be operated the year round. Estimating the hatching season to open March 1 and to continue until August 1, gives a hatching period of 153 days. It requires 21 days to hatch chickens under a hen or in an incubator, so that in the period referred to the machine could be charged at least seven times, which would call for the use of 52,500 eggs. If 50 per cent of these hatched, it would mean over 26,000 young chicks, and if 75 per cent came out all right the hatch would be over 39,000 chicks. Giving each hen 15 eggs, it would take 3,500 hens to incubate 52,500 eggs, and if only 12 eggs are given to each hen, it would require 4,541 hens to do the work of the incubator.

Rural Letter Carrier of Egypt

Egypt has emulated the example of the United States and established a rural free delivery service. The rural mail carrier of Egypt is a different looking kind of individual from the American carrier, and his equipment is also quite dissimilar. The neatly equipped wagon, such as is furnished by the Rural Free Delivery News of Chicago to the rural mail carriers of the United States, has no place with the Egyptian carrier. To him the camel serves the double purpose of horse and wagon. The camel stalks his way across the desert to rural homes leagues apart and makes better time than the American mail horse. The route of the Egyptian carrier is beset with varied dangers from wild beasts and robber bands and hence he always goes heavily armed, like the carrier shown in the illustration.

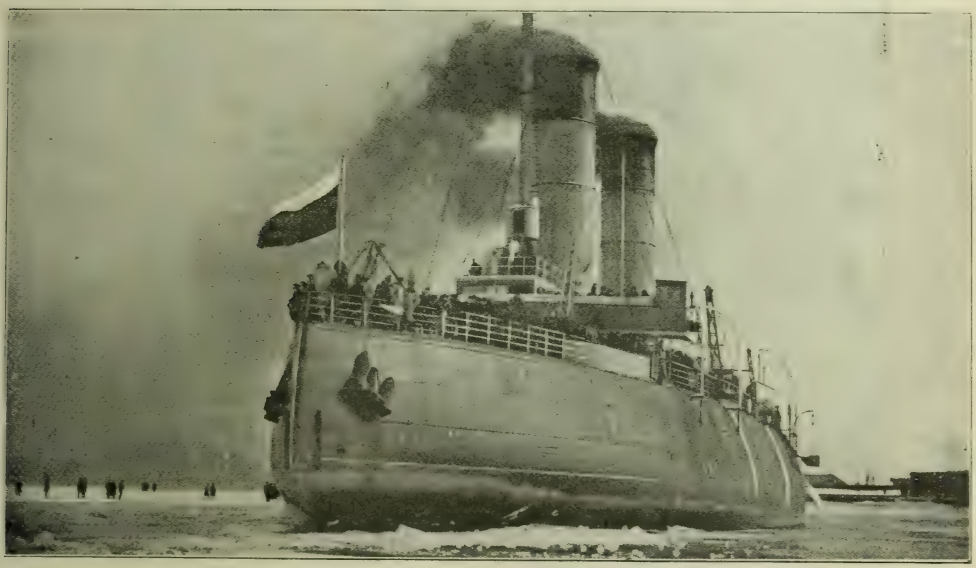
Russia's "King of Ice Crushers"

The Ermak Plows Its Way Through Frozen Seas and Never Falters In Its Course

Forcing its way through the thickest ice, crushing the frozen seas beneath its mighty weight and pursuing its course in the far northern waters directly and uninterruptedly as in a tropical bay, the Russian ice-breaker "Ermak" is the king of ice-crushers and the most effective harbor-opener ever devised. It remained for Russia, the land of ice, to produce an ideal ice-crusher.

The Ermak is of 8,000 tons displacement and 10,000 horsepower. The vessel is so designed that it rides on top of the ice and crushes it beneath its great weight. It is of remarkably substantial construction and although in a continuous collision when making its way through the frozen waters, it has never yet suffered damage. The Ermak has shown that the full forward form, or spoon-shaped bow is not successful in hard and packed ice, as the vessel pushes the ice in front of herself, instead of cutting and dispersing it. The moving parts of the machinery and the shafts must be extra strong and largely in excess of ordinary practice. On the engines it is preferable to have direct steam reversing gear, as the "all round" type is a very heavy tax on the engines when the ship is ice-breaking.

The speed of the Ermak through 24 inches of solid ice, with 6 to 12 inches of snow on it, was 9 knots an hour, and she could charge and demolish packs of ice 20 to 35 feet thick. She has been of great service on the Baltic coast of Russia in assisting vessels out of danger. In one season she rescued and assisted shipping of over $10,000,000 value, and in another winter she salved the Russian battleship Grand Admiral Aprixine, of $3,750,000 value.



Russian Ice-Breaker "Ermak" Forcing Her Way Through Ice in Kronstadt Harbor

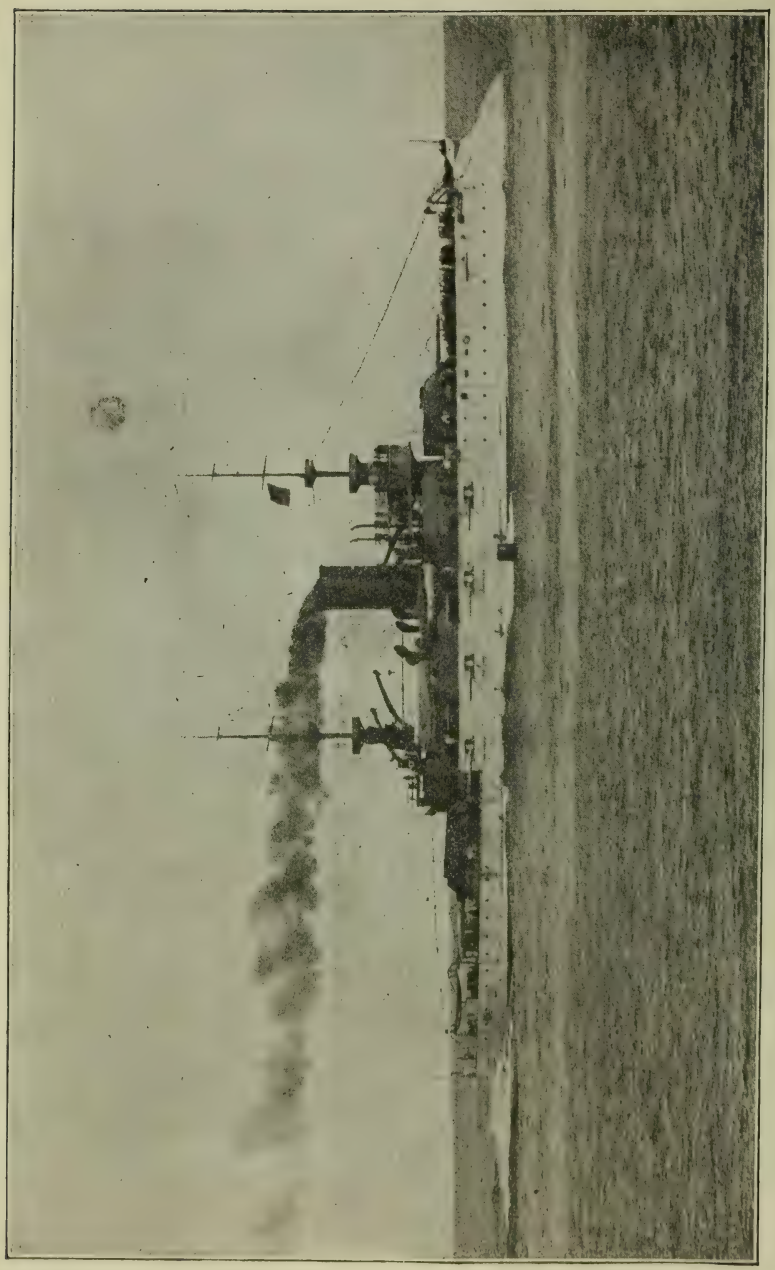
The Russian fleet usually wintered at Kronstadt, but with the Ermak in the Baltic, it could be put to sea as she could easily guide them to open water; indeed, there is nothing to prevent the Ermak from being made into an armed cruiser.

THE PAPER FOR THE WORKINGMAN.

Elmer Burlingame, of Peru, Ind., in renewing his subscription, says:

"You have the right paper and you handle it in the right way for the workingman."

Popular Mechanics, as you have noticed, is improving all the time and you are sure to find the five-year subscription a good investment.



The Alabama at Full Speed

Copyrighted 1903, by E. Chickering, Boston, Mass.

The Alabama's Splendid Gun Record

Accuracy of Aim Almost Perfect as Demonstrated by the Skilled Gunners

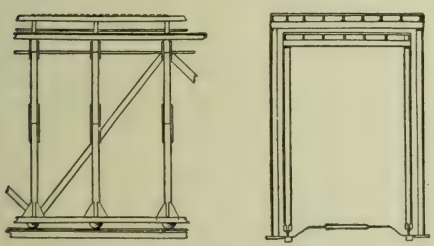
The record in target practice recently made by the warship Alabama, is one that any ship in the navy might be proud of. The Alabama has an armament of four 13-inch guns in turrets, fourteen 6-inch, sixteen 6-pounders, six 1-pounders and four machine guns. With a 13-inch gun, two hits were made on a target in two minutes. Gunner Bright with No. 4 gun in the after turret made four hits in two minutes and 8 seconds—this while the target was 1,600 yards away and while the ship was steaming at the rate of 8 knots an hour.

Seamen Allen and Fletcher on No. 3 gun scored 1.14 hits per minute, the highest average to date for any guns. Of 16 shots all hit the target but one, and that hit the floating frame on which the target rested. The target was a rectangle canvas 21 feet wide by 17 feet high. This miss, fired at a battleship, would have struck the vessel just on the water line, a most vulnerable place. The percentage of hits with the big guns was 93.75.

The result of all this rapid accurate work in actual warfare would be something tremendous. It has been proved that the Alabama's 13-inch gun can be fired so that each gun makes 1.14 hits per minute. They throw 1,100 pound projectiles and if the four guns were brought to bear on the same point, 4,400 pounds of steel projectiles loaded with high power explosives could be hurled in 1¼ minutes. The shell for the 6-inch guns weighs 100 pounds. The Alabama carries fourteen 6-inch guns, seven on a side. Of course but seven can be fired at the same object, but if the best average of the gunners were kept up, 45.85 shots could be fired, with accurate aim, hurling 4,585 pounds of shell through the air each minute. Eight of the sixteen 6-pounders can be trained on the same target, so with the record of 10.59 hits a minute with the eight guns, 84.75 shots would be falling on the enemy's vessel a minute. Meantime the 1-pounders and machine guns would add their steel hail to the storm. That is the way the naval experts reckon it, and they claim that with such accurate shooting three minutes would be sufficient to put a quietus to any hostile vessel afloat.

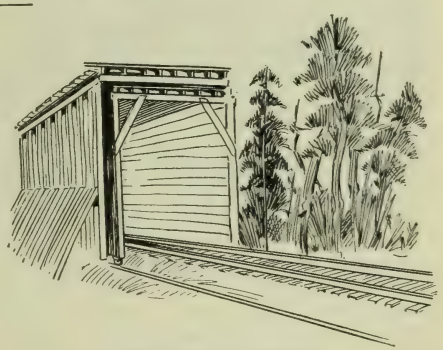
Snow Sheds on Wheels

On the Sierra Nevada mountains the daily downfall during the long winter accumulates in many places to a depth of 60 feet. The entire mountain division of the Central Pacific road is the scene of a contest lasting the entire year. In the winter it is a fight to keep the line from being blocked with snow; during the summer the snow brigades are constantly on the alert to prevent the wooden snow sheds from burning



Side and End Views

up, as there are miles upon miles of these sheds, representing hundreds of thousands of dollars, their preservation becomes an



Telescope Snow Sheds

important matter to the railroad company. To lessen the exposure to fire and to make the distance through which passengers must ride in darkness as short as possible the company's engineers conceived the idea of building the sheds on the principal of a telescope. This is accomplished by placing sections of sheds, 50 feet long, on wheels which rest upon a single rail track, one under each side of the rail. When summer comes the sections are run together

and several housed under one section. A thousand feet of sheds are thus reduced to 200 or 250 feet. Even with this precaution, and the further effort to throw the exhaust to one side instead of straight up, fires are of daily occurrence, and fire trains must be in readiness day and night. These trains consist of locomotive, a car equipped with powerful fire pumps, and several tank cars filled with water. Powerful blocks and tackle are carried with which to pull down the sheds if the water gives out and the fire cannot be controlled in any other way. Four of these fire trains are in constant service and when a call is sent in these trains are given right of way over all others. The Railroad Gazette says: "In spite of all these precautions a fire will sometimes get under way and, fanned by the fierce winds which blow out of the canyons, will destroy some miles of sheds before it can be checked."

Early Homes of Mormons

Buildings With Many Apartments Each of Which Was Occupied by a Wife

The original typical Mormon home consisted of a one-story building with numerous apartments all adjoining with a long wide porch extending across the entire front. The homes were generally built of stone or brick. Each apartment consisted of two rooms and was occupied by one wife. The building shown in the illustration, is known as "The Rookery," and illustrates a typical Mormon home of the original type. "The Rookery," yet stands in Salt Lake City on East Brigham street. It is composed of ten two-room houses joined in one and was

"THE ROOKERY," WHERE A MORMON LIVED WITH HIS TEN WIVES.

the home of a Mormon with ten wives. The wives all lived contentedly together and the entire colony was frugal and peaceful. There were few crimes ever committed. Drunkenness, theft and frauds were unknown to them and the colony thrived and grew with remarkable rapidity. Their settlement was in the midst of the desert, which land they sought in the hope that their isolation would permit them to follow their religion and creed uninterruptedly. Brigham Young has been called the first irrigator in America. The Mormons by early irrigation of the land made the desert bloom. Their land, previously regarded as uninhabitable, was soon spotted with green fields and prosperous homes. In time it became one of the prettiest countries in the world and then other people flocked there and at once made efforts to drive the Mormons out or compel them to abandon their detested religious practices. The doctrine of polygamy was the most objectionable to these new comers to the land of the Mormons and by a legislative act this was made illegal. The Mormons are now considering the advisability of going into the desert of New Mexico, or some other such land, where they will strive to establish a colony where they may yet be permitted to live and worship according to their own belief. The doctrine of polygamy, is so repulsive to Americans, however, that there is little chance of the sect escaping interference, notwithstanding the constitution's guarantee of freedom of religious worship to inhabitants of the country.

An important institution of the Mormon home, as established by Brigham Young, was the "scrap room." This was equipped with barred windows and was where angry wives were required to assemble to settle their controversies when disputes arose between them. Mormon children do not call all the husband's wives by the title of "mother." Brigham Young established the custom that, to the children of one wife, all the other wives of the father should be known as "aunt." All the children of all the wives, however, call each other brother and sister.

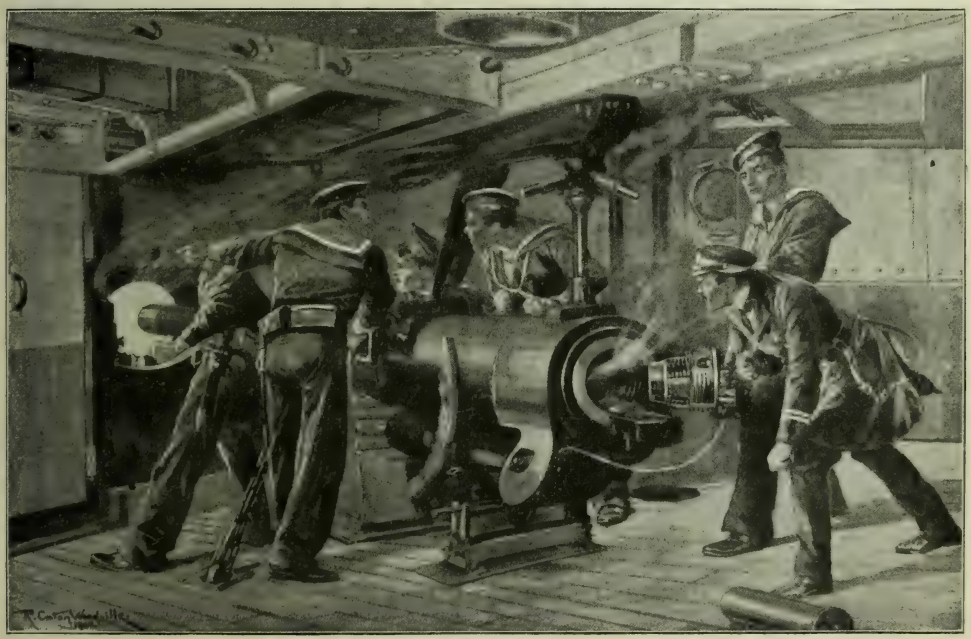
In the Harems of Europe and Asia where one husband often has a multitude of wives, it is the general rule that mothers-in-law are not permitted to speak to the wives, except by signs. These signs, between mother-in-law and daughter-in-law, however, are often more effective than words and not infrequently result in "unpleasant feelings."

Russia's Herculean Task in the Far East

How Her Success or Failure Depends on One Long Single Track Railroad

By Guillo Grey

Renewed activity in the far East, manifested during the last days of March, leads to the belief that the Japanese-Russian war is now beginning in earnest. The breaking up of the ice in the northern waters permits of better operation in the fleets of both nations and both sides are rejoicing that the severe Russian winter is nearing an end. Lake Baikal, however, will be frozen solid until the end of May, but when the ice does begin to thaw the problem of transportation across the obstructive body of water will be considerably lessened. At present the lake is crossed by means of horse-cars and sleighs. When the ice is thinner Russia's powerful ice-breakers will be put to work and the troops, horses and provisions will be transported across the lake by means of ferries.

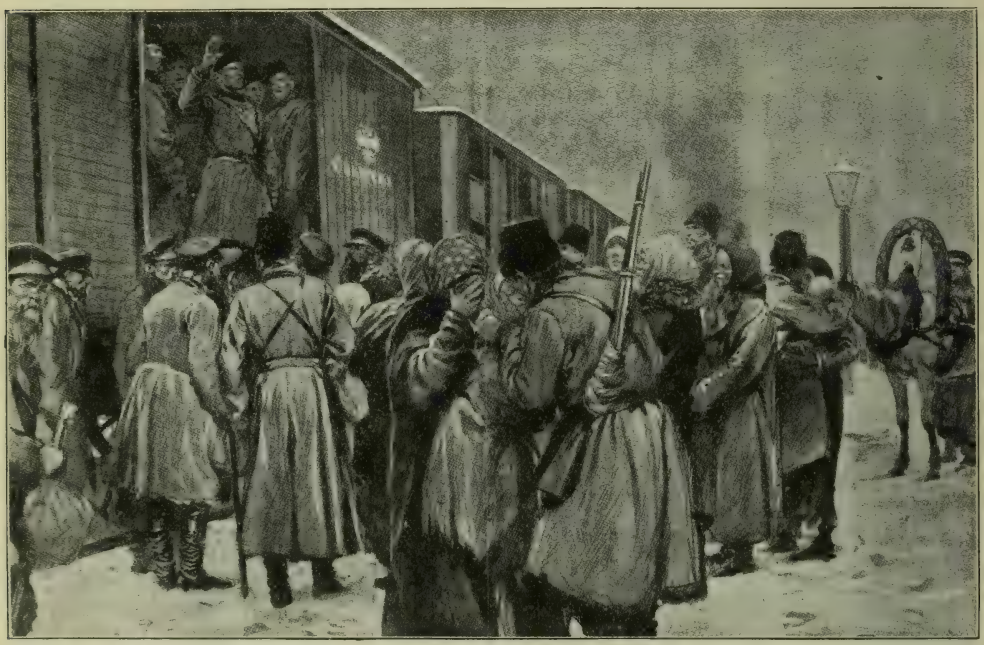


The First Shot--Scene on Board a Japanese Battleship at the Port Arthur Battle

In the struggle, the far-reaching consequences of which are difficult to predict, every advantage sems to lie with Japan. The Mikado's country has by far the superior navy; she is ideally situated relative to the scene of hostilities, being near and possessing excellent facilities for the handling of troops and provisions. Japan, being warm, can grow provisions for feeding the Japanese army, while Russia is still covered with ice. There are hundreds of sources through which provisions may be sent to Japan from all parts of the world and easily conveyed from Japan to the soldiers and sailors at the front. Port Arthur, Manchuria and Korea are virtually at Japan's door, and provisioning the army and navy is a secondary question for the Flowery Kingdom. The Japanese from the proximity and from the late war with China are familiar with every mile of the territory

in which the war is being waged. Then Japan has all the advantage of the lengthy preparations she had made for the struggle, during which her navy was put in spick-and-span condition; her army drilled and equipped; her larder filled to overflowing; her friendship with other nations strengthened, and her plan of campaign carefully mapped out.

Not one of these advantages can be claimed for Russia, and this is why army experts predict defeat for Russian arms. The Russian navy is now remarkably inferior, damaged by Japanese attacks and divided. Russia had made inadequate preparations for the war and was taken completely by surprise. Her navy was unprepared and scattered; her army, far removed, unrecruited, poorly drilled, divided and unprovisioned. While to the Japanese it will be like fighting on their own soil, to the Russians the field of action, although Russian territory, is like a foreign country separated by thousands of miles of land and water. One single-track, newly constructed railway, poorly equipped, is the sole dependence of the mighty Russian empire, covering one-sixth the territorial surface of the globe, to send its troops to the seat of war, 4,000 miles removed from the home base, and to feed them after they are there. Never was the importance of a railway in war more clearly set forth than in this Trans-Siberian line at present; never was more dependence placed in a railway than in this. If the Trans-Siberian line fails Russia, all is lost to her. Her vast army, her ships, her rough-riders avail nothing then. Withal, never was a road more beset with obstacles, varied disadvantages and more ill-fitted for the herculean task it is called on to perform. Dangers by ice, snow, robbers, dynamite and new construction threaten the entire 4,000 miles of its length. In this 4,000 miles of distance there are 100 miles of bridges to cross, the destruction of any one of which would mean disaster to Russia. That is why Russia now employs an army of 50,000 men to guard this railway alone; that is why any person walking on or touching the railroad away from the stations is shot without question or ceremony.



Away to the Far-off Front--Russian Soldiers Traveling by the Trans-Siberian Railway

There are now said to be 200,000 Russian troops in Manchuria and tacticians declare that a single line of railway can only supply an army of half this size. Japan is seemingly in position to cut off Russian sup-

plies sent from any part of the world by any other route than the Trans-Siberian railway.

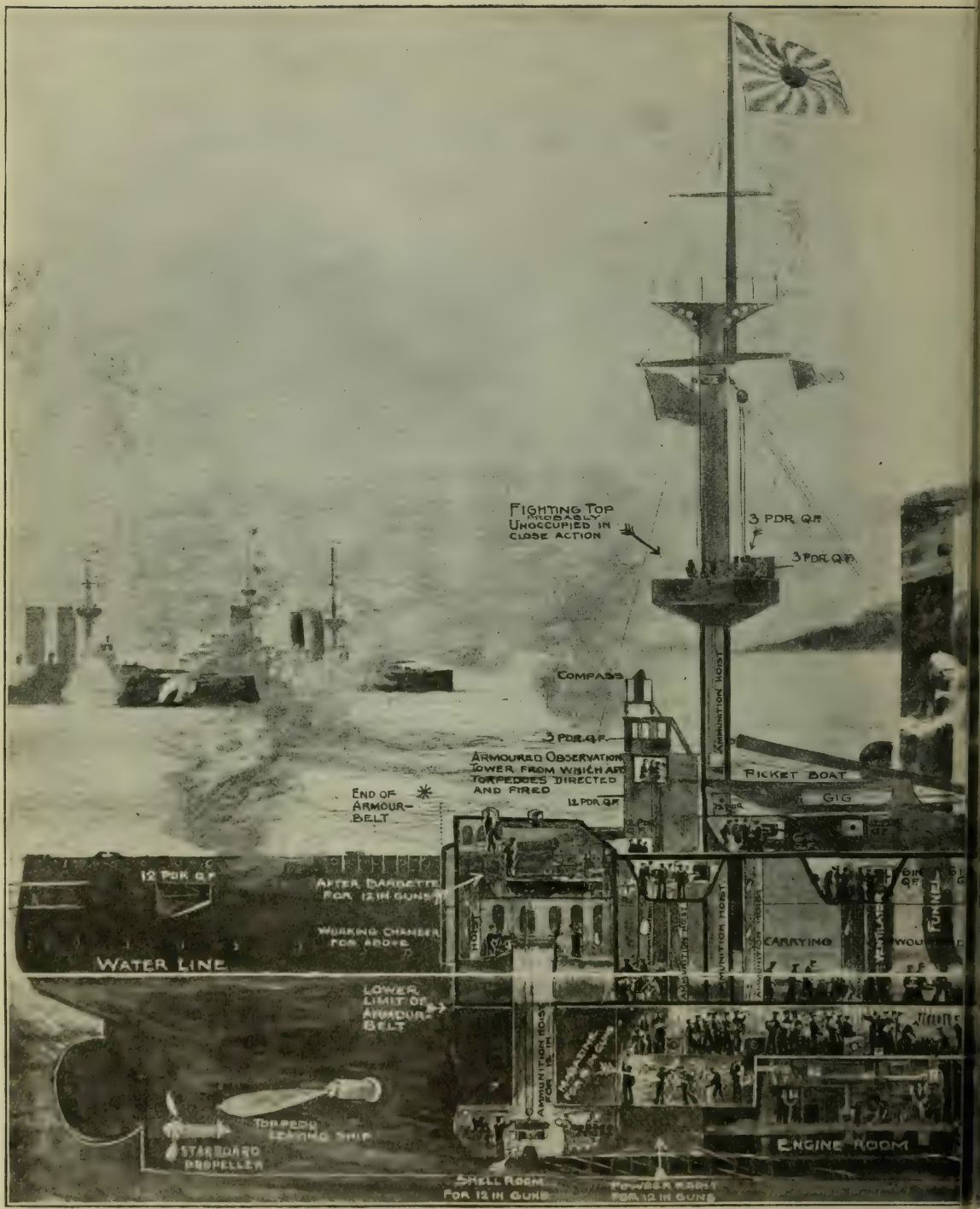
On the Trans-Siberian railway, through an extraordinary effort, seven trains are being dispatched every day. This is the limit of the road's capacity. The transport of an army corps numbering 25,000 men with 144 guns requires 112 trains and requires 16 days to load. Manchuria is not a food-producing country, cattle are scarce and oats are grown solely in the northern part near Harbin and then not in any great quantity. There are but four flour mills at Harbin and they are now taken over by the troops. The natives are most unfriendly and will not bring in supplies; hay, required for the artillery horses, which are imported from Russia, is most difficult to procure. Port Arthur is deemed in a sore plight, for the Japanese will undoubtedly capture all the provisions being sent there by water, unless the Japanese fleet is speedily driven away, and that is exceedingly improbable.

After Russian supplies have reached the field of action over the single line road, the trouble is yet not ended. Transporting the supplies from the train to the army depots is another problem. The Russians transport their stores in two horse carts with two wheels and the horsing of these carts will constitute a great difficulty. Doubtless they and the Japanese will use the mule of the country for transport purposes. The feeding and horsing of the field batteries will give the Russians the most trouble.

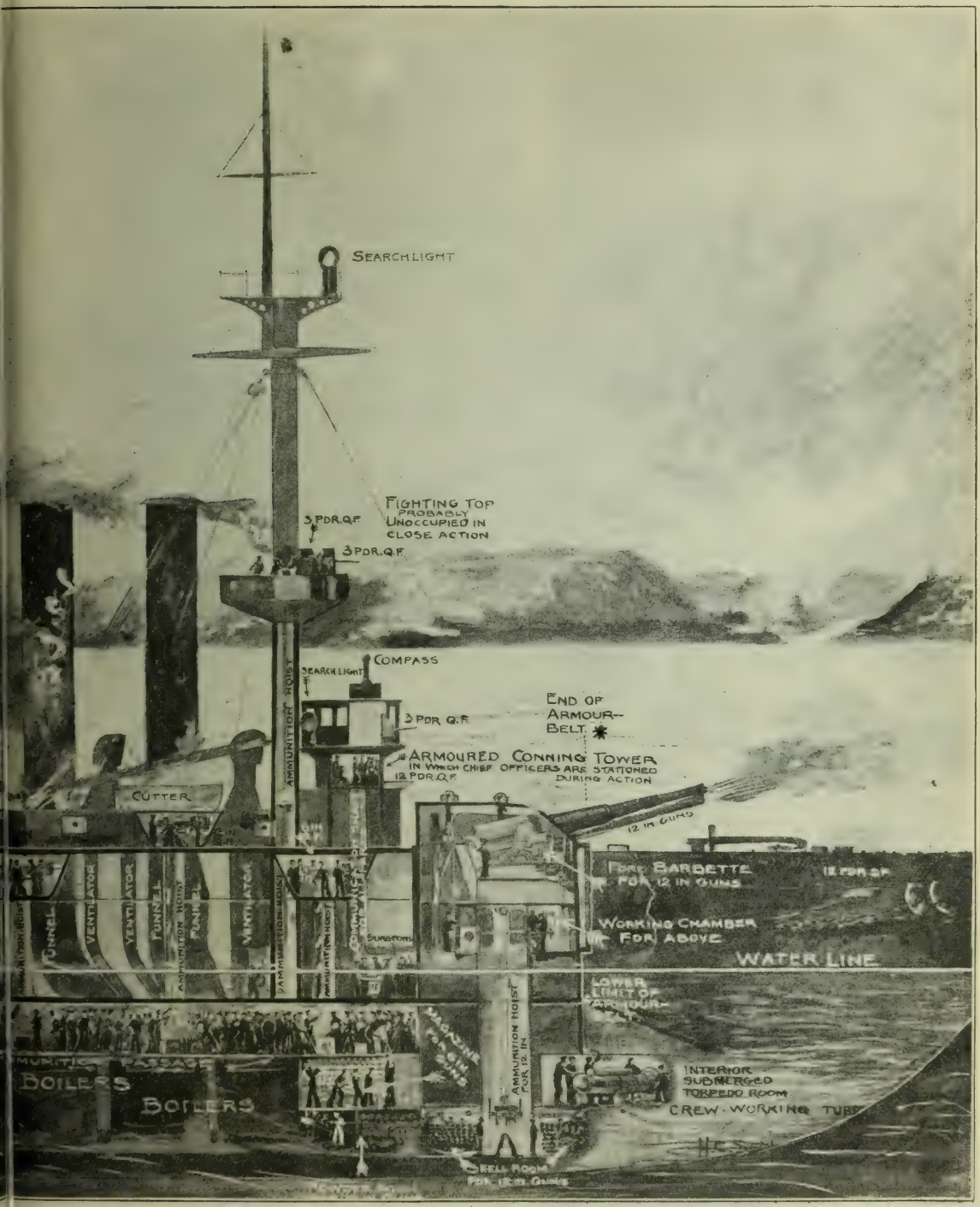
Cossacks Guarding the Sungari Bridge of the Trans-Siberian Railroad

In contrast with the meat-and-bread-eating Russian, the Japanese has his ration—rice and dried fruits, roots and fish—which enables him to get considerable assistance from the country in which he is fighting, the Manchurian and Corean eating almost the same food, so that for the majority of his supplies he will not have to fall back on his base in Japan, but can collect from the friendly native.

The system of transporting supplies from Japan is most perfect. All supplies are done up in packages, covered with matting, of a size that can be easily lifted by two men. There is, therefore, no waste and the difficulty of transit is reduced to a minimum. These packages are put on steamers, then transferred to smaller tugs, of which the Japs have plenty and the Russians none; then from the tugs to the small boats, where again the Japanese surpasses the Russian, as he is a born boatsman. For this reason the Japs seized the waterway to Tientsin in 1900, whereas the Russians seized the railway; and it is beyond doubt that the Japanese will use the waterway from Newchwang to Mukden as a means of transport



Interior of a



Japanese Battleship.

during this, as well as in the China-Japan war. The Japs, on the other hand, having command of the sea, bring their wood from Japan in small bundles, as they did in the time of Boxer troubles.

From the shore, on which, owing to their draught steamers and small boats, they can land with facility at many points, their supplies are transported to bases in light carts, most adaptable to the country they will have to fight in. These vehicles are in strong contrast to the heavy Russian cart. The Russians have no corps of transport men, save the Cossack, whereas the Japanese troops may confine their duties to fighting, for they bring their own corps of coolies—strong, well-built men, capable of doing the best of work.

The Trans-Siberian railway, on which Russia depends for success or failure in the present war, is in construction and equipment similar to the railway lines in the western United States about 20 years ago. The rails are light and old-style engines, as the illustrations show, are employed to haul the trains. Among the greatest of the many obstacles Russia has to contend with in transportation over the line is Lake Baikal, the Chunchuses or Chinese bandits, and Japanese interference. Once traffic on the line is intercepted, either by the wreck of a train by bandits, the blowing up of bridges by the Japanese, or other cause, the source of supply for the Russian army is cut off, and it would seem that nothing but surrender awaits the Czar's forces. Lake Baikal is 1,500 feet above sea level, is 4,000 feet deep and covers an area of more than 13,000 square miles. It is larger than any lake in the United States, excepting Lake Superior. The field ice on the lake forms 36 feet deep. From 20 to 50 miles wide, 500 miles long and set among hills rising from 3,000 to 4,000 feet above the lake's surface, this body of water is proving a sore menace to Russia in the present crisis. The ice with which it is covered for six months in the year is constantly cracking from sudden falls in temperature and men and horses frequently fall through the cracks. A connecting line is being built through the hills around the southern end of the lake, but this will not be completed before 1905. In the meantime Russia is compelled to get her supplies across the best way she can. A railroad has been built across the ice as a means of facilitating the movement of troops and supplies, and engines were used to haul the cars until one of the locomotives a short time ago broke through the ice and disappeared. Since then the cars are pulled by horses. The rail route across the lake is 42 miles long.

There are two great ice-breakers on Lake Baikal, both of which will be put in operation as soon as the ice begins to thaw. One is the Baikal, the largest ice-breaking railway ferry-steamer in the world, and the other the Angara, which conveys passengers only. The Baikal is 290 feet long and of 4,200 tons' displacement. Her draught under ordinary working condition is about 19 feet. She has three sets of triple expansion engines, one at the bow, and two screws at the stern. The principle of subdivision is carried out in the highest degree and a large number of compartments would have to be pierced before she would sink. The vessel has luxurious accommodations and a promenade deck for the use of passengers. The vessel has three lines of rails, entered from the forward end; the entire track is very strong to carry the locomotives, which on this railway, loaded with tender, weigh from 94 to 104 tons.

The Baikal's consort, the Angara, is a fine ice-breaker, having one screw of 1,500 i. h. p. triple expansion engines and loco-boilers. These boilers were adopted so as to get over the difficulties of transshipment from St. Petersburg to Lake Baikal. The Angara makes her passage with the utmost regularity with mails and passengers.

About 500 tunnels and bridges are necessary in building the railway around Lake Baikal, and as the valleys are very steep and work can only be carried on during the open months, the engineering difficulties are apparent. No other section encountered in the construction of the entire line was nearly so difficult as this. On the lake is the only present interruption on the line. The western section which extends from Cheliabinsk, on the European frontier, to Pochitanka, 1,080 miles, runs for 880 miles over a plateau so level that the distance exceeds an air line by only 2½ per cent. There is a tunnel on the trans-Baikal section which was an open cut, roofed with a stone arch to save the roadbed from landslides. There are snowsheds and fences to the extent of 565 miles. The trains make fairly good time with the exception of the stops which are excessively long, being of from one to six hours' duration.

The cost of the system up to the present time has been more than $200,000,000. The building of the line around Lake Baikal and

the regrading and relaying of a large portion of the roadbed will add a large amount to this.

For a troop train to make the trip from Warsaw to Manchuria requires about 30 days. Each troop train is provided with a restaurant car and the men's meals are cooked at the various halting places where barrack accommodations of a rough sort are usually provided. It is estimated that only about 5,000 troops per week can be transferred from Russia proper by means of the railway, as the number of sidings, especially at the eastern end of the line, is very limited. The danger to the high-pitched embankments from trains laden with heavy artillery must not be overlooked.

Building the Railaway Over the Ice Across Lake Baikal

That the permanent way of the railway will prove equal to the strain of the constant traffic demanded of it during the next few months is more than doubtful. M. DeWitte, who inspected the eastern portion of the line last summer, found that it had been very badly laid in many places, light rails having been substituted for the heavier ones contracted for. He was accompanied on his trip by Chief Engineer Alexis Yogorivich, who built the main portion of this line, and it was found that the Russian contractors had scamped their work in many respects. The rails for a great portion of the road were made in the United States.

Lake Baikal being crossed, the next serious danger the troop trains must guard against is that of the destruction of the track by the "Chunchuses," or Chinese bandits, and by the Japanese spies. For months past the spies have infested the eastern portion of the line in every possible disguise and are sure to attempt to destroy any weakly guarded bridge. The railway crosses several large rivers and also several smaller tributaries of the Amur and Sungari, and when once one of these large bridges has been destroyed, it will be weeks before repairs can be made and traffic resumed.

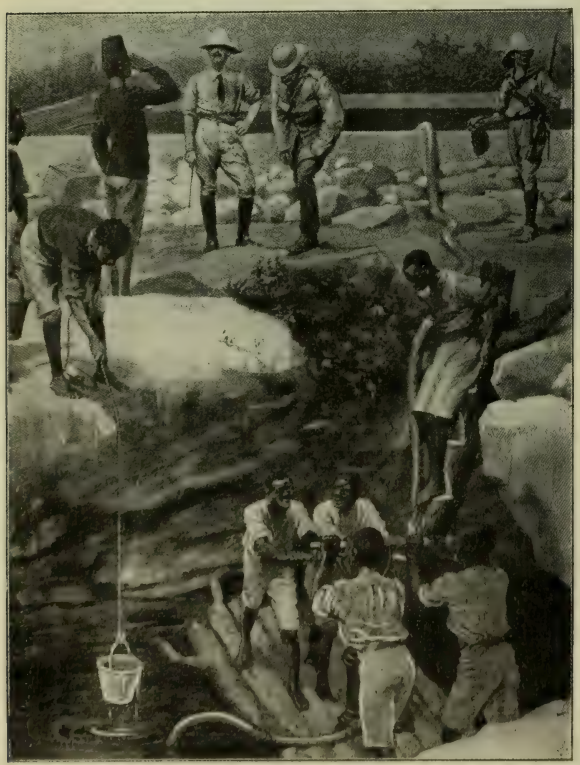
The Novoe Vreyma, Russia's leading newspaper, reports the Chunchuses have lately been exceedingly active in their attacks on several of the smaller posts and bridges in southern Manchuria, more especially that portion of the line which extends from Harbin to Port Arthur—in all a distance of about 700 miles. These bandits are reported to be 200,000 strong. They have an abundance of small arms and ammunition. They consist principally of disbanded soldiers of the Chinese army who have been drilled by foreigners. They are as good shots as the Siberian Cossack and their shooting is their living. The robbers have a well organized system and their profession has proven most lucrative. They are in a way honest, for they give passes

to the villagers who bring their produce to Newchwang, both by water and roadways. Carts and boats holding passes from these robbers carry the flag of the band that issued the passes, and strange to relate, these passes are always respected by the members of other bands. So that once having paid his toll to the robber, the villager goes on his way rejoicing, well knowing that he has nothing more to fear. The Japanese when they took possession of the country following the Chino-Japanese war, seeing that they could not cope with the bandit, allowed him to carry on a trade which kept the country settled to the satisfaction of both villager and bandit, and did not interfere with their trade, as if they regarded it legitimate. The higher Russian authorities, since the Russians took possession of Manchuria, have endeavored to put down the robbers, but the lower officers have only opposed the robbers when they failed to meet their demands, which has often led to trouble.

It was the bandits who destroyed the Trans-Siberian railroad between Mukden and Port Arthur during the Boxer trouble, carrying away rails and sleepers for miles, cutting the iron bridges into small pieces—a feat one would think impossible, but they get the villagers to help them and work like ants. Not only pickets along the entire line, but strong bodies of troops at close intervals are required to protect the Trans-Siberian road from these bandits, for they are daring to a degree and have past grievances with the Russians to settle. The Chinese have sent Yuanshe-Kai and his army corps to the great wall at Shan-hai-kwan to keep these robbers from infesting China, if driven out by the Russian troops. The robbers and the natives both hate Russia and are friendly to Japan.

With these numerous obstacles to encounter it is plain to see that Russia is unlikely to defeat Japan unless her soldier is by nature a superior individual and fighter to the Japanese.

Bad Water Balks the British



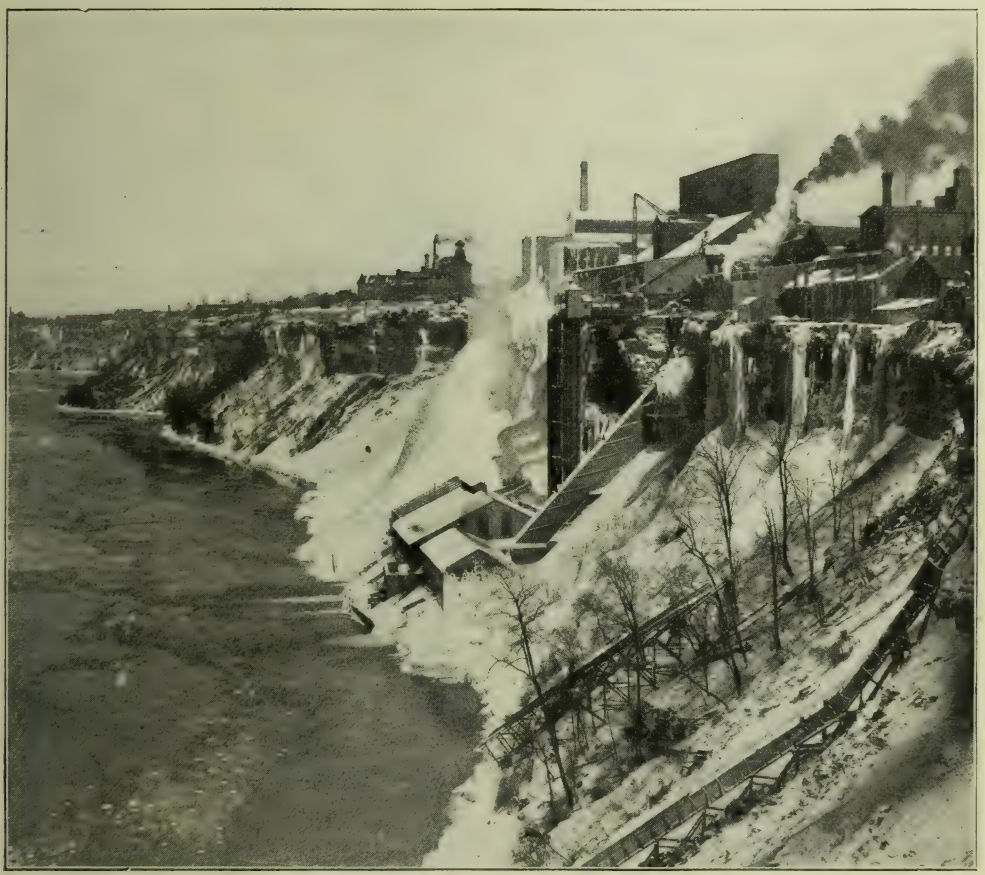
Purifying Water in the Nogal Valley—Somalliland

Ill-tasting water has proven one of the most formidable obstacles the British soldiers have experienced in their invasion of Somalliland. So maladorous and repulsive to the taste is the water that it must be distilled before it can be drunk. The illustration shows how the natives of Somalliland are forced to pump the water from the natural springs into tanks for the convenience of the English campaigners. The scene is in Nogal Valley—the Stony Country. Here the wells are principally caves in gypsum rock. The water in them is impregnated with sulphuretted hydrogen. Natives however, drink the water with relish and without any apparent ill effect.

The British soldiers have devised a method of "aerating" the water to make it palatable. A large sail cloth tank is erected on the brink of a well and into the tank the water is pumped. After exposure to the sun and air the unpleasant smell and taste disappears and after the water has been further treated by a cooling process, the soldiers are enabled to drink it.

Icicles at Niagara Weighing Hundreds of Tons

Icicles weighing hundreds of tons each, and great blocks of solid ice as large as hills, threaten to fall and carry away valuable property at Niagara Falls. Thousands of tons of water, which formerly passed over the falls, have been diverted and now are conducted through great canals to a point below the falls for power purposes. As the water emerges from the turbine wheels it flows into the torrent below, but the past winter has been so severe that even this dashing flood has been caught and held in the grasp of the ice king. Constantly increasing in size by day and night, there has accumulated thousands of tons of ice, which now threatens to break away from its position and falling 150 feet, destroy the power plants below and carry the wreck into the foaming torrent. Another danger is also imminent, the ice mass may carry with it great portions of the cliff itself. Dynamite has been suggested as a means of detaching the ice.



Ice Dangers to Power Plants at Niagara Falls

WASHING BY THE POUND.

A laundry in Utica, N. Y., which does washing by the pound has issued a card stating its rates. Finished washing is done at ten cents per pound for 10-pound or more washings. This excludes dresses, shirt waists, shirts, collars and cuffs and allows but one skirt to each dozen pieces.

Rough dry washing costs but five cents per pound. Everything that ought to be starched is starched and all flat work such as sheets, slips, napkins, etc., are ironed.

This enables families to send their entire washing, as the rates are much lower than home labor could afford.

Japanese at Last Our Friends

Formerly Insulted the United States Flag and Shed American Blood--How They Were Punished

By Paul Orr

America is indebted to England for the friendly relations now existing between this country and Japan. Prior to England's effective good offices, Japan killed our sailors, fired on our flag, repulsed our merchant steamers, burned the American consulate, detained shipwrecked American seamen, renounced treaties with us, and on July 16, 1863, a naval battle was fought between this country and Japan, resulting in a victory for the United States. As a result of this battle Japan was forced to pay $750,000 indemnity.

In the battle four sailors and a marine of the United States ship Wyoming were killed, many Americans were wounded, and 100 Japanese were killed. The battle was in the straits of Shimonoseki and the little boat Wyoming was pitted against three Japanese ships and several land batteries, but it was Americans the Japanese were fighting then, and the American victory was complete.

The cause of the battle was the action of the Japanese, a short time before, in firing on the defenseless American steamer Pembroke. The Pembroke, freighted with merchandise, bound from Yokohama to Nagasaki, was nearing the eastern entrance of the Shimonoseki straits, with the American flag flying. The powerful batteries of the forts and the war vessels opened fire on her and she was compelled to put out to sea again. The United States Minister, Pruin, under orders from Washington, at once sent the Wyoming to the scene of the attack, to demand an explanation for this latest Japanese insult to the American flag. The Wyoming was in command of Commander David Stockton McDougal, who died a rear-admiral. When he entered the straits he had the port holes of the Wyoming covered with tarpaulin so that she looked like a merchant vessel. Two square-rigged vessels and a steamer could be seen in the narrow entrance to the straits.

"Gentlemen, we will either blow those ships out of the water or sink ourselves," said McDougal to his officers. He noticed that the center of the channel was marked by a stake. He suspected that the guns of the fort were trained on this point and so gave orders to run in close to the northern shore. It was this foresight that saved the Wyoming from utter destruction at the hands of the Japanese. The American flag was run up and the little Wyoming made for the first ship inside. The Wyoming carried only six guns, while the combined armament of the Japanese ships and forts amounted to 48 guns. The Lanrick, one of the Japanese vessels, poured three broadsides into the Wyoming. The American vessel replied with such vigor that the Lanrick was soon in a sinking condition. As the Lanrick went down, the Daniel Webster, an American built Japanese vessel, opened up on the Wyoming with the same result. The two Japanese vessels being sunk, the third, the Lancefield, tried to escape. The Wyoming gave her chase and after a few well directed shots she was blown up. Commander McDougal then turned his attention to the forts, silencing them. While the Wyoming destroyed three vessels, killed more than 100 Japanese and silenced all the forts, only five of the Americans were killed, but quite a number were wounded. The hull of the Wyoming was hit ten times, her funnel had six holes in it, two masts were injured and the upper rigging was badly cut.

As early as 1831 the United States in an effort to regain the friendship of Japan returned to her coast a number of shipwrecked Japanese sailors. Upon the arrival of the American ship Morrison, containing the Japanese sailors, the Japanese misconstrued our intentions and fired on the ship and repelled her with violence. The American ships Columbus and Vincennes were sent to Japan to demand a hearing. The Japanese then condescended to listen to our petition for a commercial treaty, but steadfastly refused to enter into any friendly relations with us whatsoever and the American ships returned disappointed in their mission.

In 1849 some American seamen were shipwrecked on the Japanese coast, and instead of returning them to the United States as the Americans had returned the shipwrecked Japanese seamen, the Japanese took the Americans in custody and would not even permit them to be returned to American shores. It was necessary for the United States to send the sloop Preble,

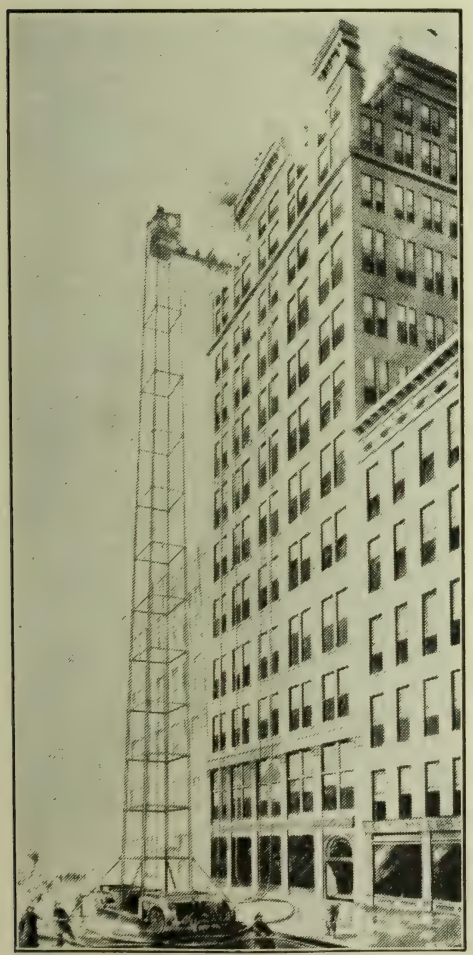
Capt. Glynn, to secure the release of the American seamen.

In 1854 the United States, through Commodore Perry, finally succeeded in obtaining a treaty with Japan, according to which the ports of Simoda and Hokodadi were opened to the United States. In 1857 Mr. Harris, consul-general of the United States, made a new treaty opening the port of Nagasaki. These treaties were repeatedly violated, however, and caused great antagonism.

Several years after that Japanese hostility toward the United States assumed more threatening proportions and finally the United States legation was burned. Next followed the action of the Japanese in firing on the American steamer Pembroke while flying the American flag, and the battle between the three Japanese ships, the Japanese forts and the Wyoming.

Elevator Fire Escape and Stand Pipe

A fire escape and stand pipe which does away with the climbing of ladders and the carrying of hose; which can be operated easily and afford an absolutely safe escape for persons in the highest stories of burning buildings seems scarcely reasonable even in our day of high attainments. Yet such a fire escape has been invented by Israel Hogeland, of Indianapolis, Ind.



Fire Escape in Use

By means of compressed air this escape can lift or lower in 30 seconds, to a height of sixty or seventy feet, a fireman and five lines of hose. At the top is an extension gangway over which people in the building can walk to the carriage of the hoist and be safely lowered to the ground. The invention comes at an opportune time and will probably receive the attention of fire departments in all large cities.

FEARS COLLAPSE OF BOSTON'S SKYSCRAPERS.

Danger of collapse of skyscrapers from corrosion, formerly related in Popular Mechanics, is corroborated by Prof. Charles L. Norton, of the Massachusetts Institute of Technology, who declares that every skyscraper in Boston is in danger of collapse.

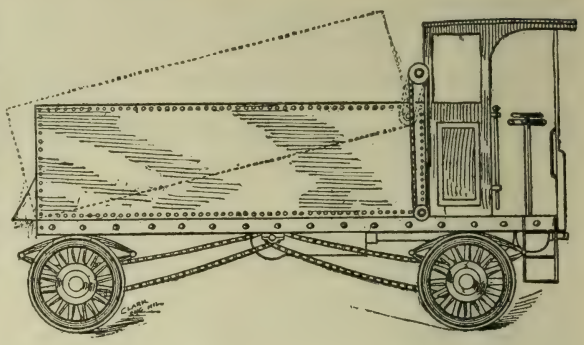
Prof. Norton says that the corrosion of steel and the consequent weakening of the structures, because of the ineffectiveness of some of the preparations used to protect the metal, should be carefully considered by builders. He condemns stone work and terra cotta as being ineffective against fire and says concrete is by far the best protector for structural material against flames.

SINKING ROCK FOR A TUNNEL

Sinking large blocks of cement that a tunnel may be bored through them is a curious feature in the construction of the extension lines of the Metropolitan Railway in Paris. Three railway lines to cross at different levels at one place, the subsoil near the surface containing water, occasioned the problem that was solved in this uniquie manner.

Freight Trucks That Climb Hills

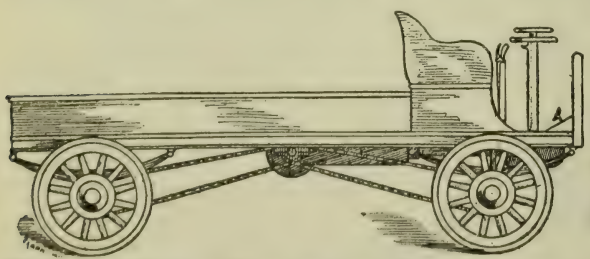
The motor freight truck is rapidly displacing the horse and mule for hauling heavy loads in our larger cities. The very large saving over animal power insures the general adoption of the mechanical power. As teaming is more costly in the larger cities, it is here the change is first being made, but in time it is bound to include smaller cities and towns. It is a question of dollars, and in the comparison the motor truck is an easy victor.



Coal Truck, 7-Ton Capacity, 50 Horsepower—Speed 6 Miles An Hour When Loaded

The use of motor trucks has been confined chiefly to level and well paved streets, but their field of usefulness is to be greatly enlarged. A recent invention enables the use of each of the four wheels of the trucks as driving wheels, instead of only the two rear wheels. By this means the heavier the load the greater the tractive power of the truck, and the easier it can climb a hill. The large coal truck has a four-cylinder 50-horsepower gasoline engine which is placed at the front end, under the foot board and is readily accessible. The engine cylinders are arranged in directly opposed pairs. The impulses are so timed as to give an explosion at every stroke of the crank. This reduces the vibration caused by the explosions and reciprocating parts to a minimum. The clutch for engaging and disengaging the engine from the driving mechanism is placed in the fly wheel and is operated by a ratchet foot pedal. The drive shaft extends back through the transmission gear with bevel gear drive to a spur gear differential.

Three forward speeds and reverses are obtained by a sliding gear transmission. The ratio between engine and drive wheels on the (direct) high speed is 12 to 1; on the second speed is 24 to 1, and the slow speed and reverse is 48 to 1. The direct drive speed is six miles per hour loaded, and by speeding up the engine when empty a speed of eight miles can be obtained.



Heavy Express Truck, 2-Ton Capacity, 20 Horsepower, Speed 10 Miles an Hour When Loaded

The truck weighs 7,000 pounds and is 17 feet long by 7 feet 8 inches wide. The wagon box can be raised at one end to dump the load.

RUSSIAN RULES FOR HELP IN CASE OF ELECTRIC SHOCKS.

Russian electrical engineers have a most efficient code of rules for rendering aid in case of electric shock. Among other requirements are those for a life-saving room in every power station, this room to be equipped with all the articles and instruments necessary to its purpose, and to be accessible to every person apt to be called on for aid; rubber gloves and overshoes, subjected to powerful tests every six months, must be provided for the protection of the rescuer, whose work of separating persons from contact with live wires is dangerous. In remote cases it is recommended that dry cordage or clothing, soaked with salt water, be thrown over the wires for insulation.

These rules are placed conspicuously in all stations and have diagrams showing how to proceed in various emergencies.

Lady—"Why did you leave your last place?"

Cook—"I couldn't stand the dreadful noise between the master and missus, mum."

Lady—"What was the noise about?"

Cook—"The way the dinner was cooked, mum."

How To Do Your Own Wall Papering

Easy and Attractive Work Performed with Little Inconvenience

Fig. 1. Folding the Paper

Do not employ a man to hang your wall paper. Do it yourself. The work is easy—much easier and more attractive than laying carpets—and from the additional interest you will take in it, the prospects are that the job will be better done. To the person who is neat and possesses artistic inclinations, there is a splendid opportunity for exertions to produce tidy and pleasing effects, and nothing adds more to the appearance of a room than well dressed walls.

Select your own wall paper of a design and color best suited to the lighting and adaptations of the room. You should make careful measurements of the room before purchasing the paper.

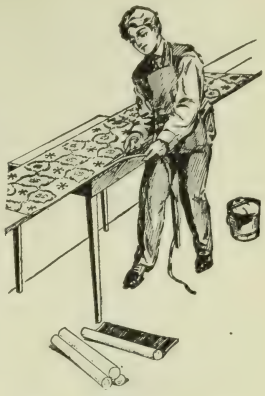


Fig. 2. Cutting the Paper

Measure the width, length and height of the room which you intend to paper. By taking the entire distance around the room, which is obtained by adding the width of the four sides together, and multiplying this by the height of the room, you will obtain the number of square feet of wall surface. You will then allow 20 square feet for each door and window. Subtract the total number of square feet of all the doors and windows from the total number of square feet of the entire wall surface of the room, and this will give you the square feet of surface to cover with wall paper. By dividing this by 60, which is the approximate capacity of a double roll of paper, you will obtain the number of double rolls required for the side walls. To find the number of rolls required for the ceiling, multiply the width of the room by the length of the room, which will give you the number of square feet in the ceiling, and by dividing this by 60, you will find the number of double rolls of ceiling paper required.

Suppose a room to be 12 feet wide by 13 feet long by 10 feet high. The total distance around the room is the total width of the four sides, as follows: 12 plus 12 plus 13 plus 13, equaling 50 feet. This multiplied by 10, the height, gives you 5000 feet of wall surface. Suppose there are two doors and two windows. Allowing for each 20 square feet, gives 80 square feet of space taken up by windows and doors. Subtracting the 80 square feet from the 500 square feet leaves 420 square feet of wall surface to be covered with paper. Dividing the 420 square feet by 60 gives you 7, the number of double rolls of side wall paper required.

For the ceiling you will multiply the width, 12 feet, by the length, 13 feet, making a total of 156 square feet. Dividing this by 60 gives you 2½ and in this case, as double rolls are not cut, you would allow 3 double rolls for the ceiling paper. For the border you add together the width of the four sides, 12 plus 12 plus 13 plus 13, equaling 50 feet, gives you, say, 17 yards of border required.

It is well to add an extra roll for each wall and ceiling, and several extra yards of border. You are apt to spoil a strip, occasionally, and when figuring you may overlook projections, such as chimneys, etc. Often an extra roll, worth a few cents, will save great inconvenience.

Before commencing you should secure all the necessary articles needed for your work. To apply the paste you will require a paste brusn from 6 to 10 inches wide—a whitewash or kalsomine brush will answer. Get a long pair of shears to insure a straight cut to trim the edges. A seam roller is required to press down and smooth the edges where each strip of paper laps over or is joined together. If you have no seam roller a bed caster will do. Be careful not to use the seam roller until your paste on the paper that is hung is partially dry. A regular paper hanger's trimmer can be purchased for a small amount but scissors will answer the purpose nearly as well. Paper hanger's knives, wheel knives, base trimmers, folding pasting table, past-

ing board, etc., add to the convenience of papering a wall, but other tools can be easily substituted.

To make your table on which to cut the paper, secure two boards about 8 feet long and 10 or 12 inches wide; lay them side by side, permitting the ends to rest on a table or box at each end. The table or box should not be more than three feet high. Now secure some planks for the platform on which to stand while papering. This can be made by placing the planks on ordinary boxes or chairs. The platform should be nearly as long as the width of the room, and so high that your head will be about six inches from the ceiling.

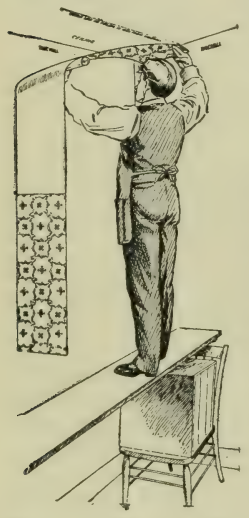


Fig. 3. Papering the Ceiling

A dry paste for use with cold water, can be bought in the form of a perfectly pure powder, and is prepared for use instantly by simply stirring it into cold water. It dissolves immediately and you can make as much or as little as you need in a moment. It keeps for a long time after being mixed. One pound of powder makes ten pounds of paste ready for use, and you can make it thick or thin as the purpose requires. But it is easy to make your own paste, entirely. To make a sufficient amount to paper a good sized room, take 3 pints of flour, rub smooth in two quarts of cold water; add 8 quarts of boiling water and let this boil slowly. Stir constantly for 10 minutes. When cold, stir in two tablespoonfuls of powdered alum. Use the paste about as thick as will run off the brush.

New walls which have never been papered should be gone over with a thin coat of size, which is made by soaking a pound of glue for 12 hours in cold water and adding a tablespoonful of powdered alum. Before sizing, all kalsomine or whitewash should be washed off the walls. If the walls have been rough plastered or have not been putty coated, rub off the projecting grains of sand with a block of wood, and if the walls are very bad, apply thin paste and let it dry before papering. Walls that have been painted should be gone over with a solution consisting of one part ammonia and six parts water, before sizing. Board ceilings or walls should be covered with cheese cloth tacked at the edges and then sized, which shrinks it tight to the wall. The row of tacks at the corners and around the casing should be about two inches from the same and the ends of the cloth pasted down. In cleaning and sizing your walls, be careful to do it thoroughly around the baseboard and casings, and you will have no trouble with your paper curling at the edges.

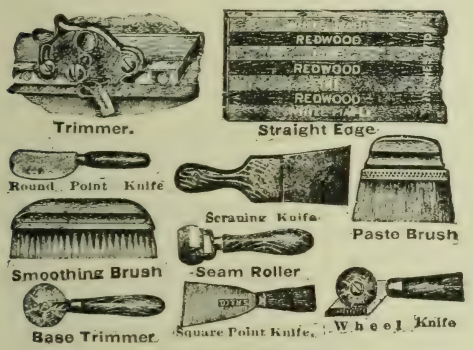
The bucket of paste should be placed on the right hand side of the operator. Paper your ceiling first, for in doing this you are apt to touch the side walls with paper that has paste on it, or with your soiled hands. As a guide for hanging the first length of ceiling paper, draw a line with chalk 16 inches from the side wall. This is done best by driving a small nail in the ceiling 16 inches from the side wall at each end of the room before starting to paper. Chalk a piece of cord; tie the same to the nails, draw it tight, then take hold of the cord in the center, pull down and let it go; the cord will strike the ceiling and leave a straight line. (See Fig. 3.)

Now apply the paste evenly on the top strip of paper beginning on the left hand end of the tables as you face the same. After you have applied the paste on about one-half of the length, lay aside your brush and fold over the part of paper that is pasted, using extra care that the sides are exactly even (Fig. 1). Now apply the paste to the other half and fold that over toward the center, the same as with the first half. If the strip of paper is longer than your table, paste the left half after folding and allow the folded end to hang over the end of the table and rest on the floor while you are pasting and folding the other half. You now have an entire strip of paper before you, all pasted and folded, and the sides of the paper perfectly even and ready for trimming. Draw the strips of paper towards you about three inches from the edge of the table and proceed to trim, commencing at the right (Fig. 2). The great advantage in trimming paper after pasting is that the paste will then be more evenly distributed on the edges. It also takes less time as you trim two thicknesses at once.

After the selvage is trimmed off, your paper will be 18 inches wide. For the same

reason that the ends of the paper should come down a few inches on the side wall, the first strip put up and also the last strip of ceiling should lap two inches on the side wall.

Take the first piece of ceiling paper, which you have already pasted, folded and trimmed. Mount your raised platform, start in at the right hand corner of the room, unfold the end of paper to your right, let the other end, which is still folded, hang over a roll of paper which you hold in your left hand (Fig. 3). Commence in the corner of the ceiling, having the first strip of paper come between the chalk line and the wall you face, allowing both the end and the side of the paper to come down on the side wall two inches, as previously explained. Now guide your paper with your right hand along the chalk line, at the same time pressing the paper to the ceiling with the flat of your hand as you move along and smoothing the same with brush or whisk broom. When half of



Paper Hangers' Tools.

the first ceiling strip is put on, then unfold the other half and continue to the end of the first strip. When hanging the second length you are guided by the edge of the first strip and so on until the last strip of ceiling is put up. The edge of the last strip should also lap on the side wall. Care must be taken to have your patterns match.

Always hang the side wall paper before hanging the border. Follow the same instructions for cutting the paper for the sidewalls as for the ceiling. The paper should be cut from 4 to 5 inches longer than the length required for the side wall that is to be papered. In cutting your side wall paper you can allow for the space of wall that the border will cover. All borders are either 9 or 18 inches wide.

Be sure to match the pattern, which is very easily done. As you have allowed from 4 to 6 inches in cutting, you can raise or lower each strip or length of paper as the pattern may require. In matching your side wall paper on the work table you will find when a large pattern is selected that there will be at times a waste of 8 or 10 inches which will have to be cut off. The upper end of the side wall paper will be uneven but the border will cover these uneven ends. The lower end which stops at the baseboard, is either trimmed with a base trimmer or a pair of shears. When using shears, paste your paper in place close down to the baseboard; use the back of the shears to mark with, running the same over the top of the paper where the top of the baseboard and the plaster meet; then lift your paper a little—the paste still being fresh will permit of this—and cut where you have marked with shears and smooth down with brush or whisk broom.

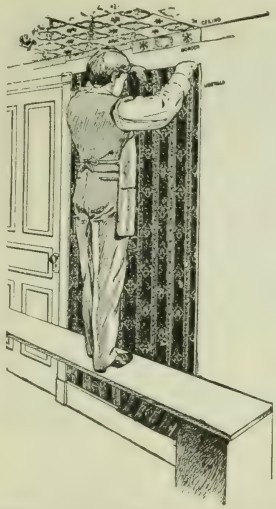


Fig. 4. Papering the Side Wall

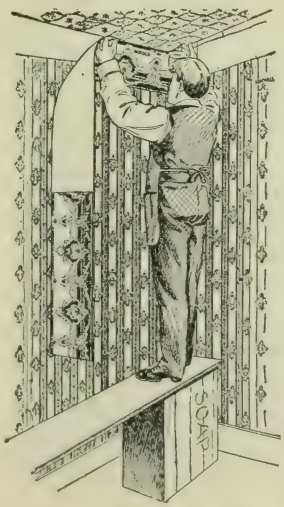


Fig. 5. Hanging the Border

To hang sidewall paper arrange your platform or step ladder so it is about 12 inches from the wall; commence at any door, as this will be of great assistance to you in hanging the first piece of side wall paper straight; then continue around the room until finished. All short pieces can be used over doors and windows.

Take your first length of paper that has been pasted, folded and trimmed. Mount the platform or ladder, unfold both ends and the entire strip hangs perpendicular. Holding the strip at both top corners (see

Fig. 4) lean forward, looking down along the edge, and when the pattern is properly matched, allow the paper to touch the wall and smooth down with a brush or whisk broom.

About ten minutes should elapse before using the seam roller, as the paste is still wet and will squeeze out at the edges. Occasionally it will happen that a strip is not properly matched after being hung. In such a case remove the strip at once and proceed over again.

The border should be hung last, and can be cut in five or six pieces, should it be easier to hang it that way. Do not commence in the corner, but have the end lap over on the wall about 4 inches. Cut the border through the center of the largest figure, as then a joint cannot be noticed after it is hung. Paste, fold and trim the border, the same as you did the side wall and ceiling. Take the folded strip of border, mount your platform or ladder, unfold the right end and proceed as shown in Fig. 5.

If the ceiling should be uneven it is best to draw a chalk line on the wall immediately under the ceiling. Make your chalk line in the same manner as described in the instructions for hanging the first strip of ceiling (see line in Fig. 5). This should be done on a line with the lowest part of the ceiling. This will leave the ceiling paper exposed above on the wall in some places. For this reason it is recommended that in hanging the ceiling paper, the paper be allowed to come down two inches on the side walls.

FIVE-YEAR SUBSCRIPTIONS.

In response to numerous requests, the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Adress may be changed as often as desired.

Wealthy Resident—"Why don't you call for more firemen, chief?"

Chief of Volunteer Firemen—"Well, you see, we get only one keg of beer for putting out a fire, and the fewer there are of us the more beer we shall have to drink."—Fliegende Blaetter.

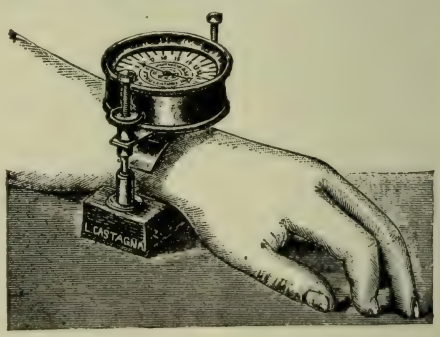
We should be glad to have our readers send us the names of any of their friends whom they think would be interested in Popular Mechanics.

PETROLEUM MAKES CLOTH WATERPROOF.

Petroleum is said to be the secret substance used in the manufacture of waterproof cloths, of which so many articles are now being made and which appear as any other ordinary cloth. The only reliable water-proofing is obtained by impregnating the cloth outside and in with a fine film of waxes. Paraffin wax is the staple, but owing to its low melting point, it is not fit for use alone. The composition used is so alloyed with other waxes and chemicals that at a boiling point, with the water, the wax stands firm. A rather elaborate preparatory form is gone through and after the wax has been applied a finishing process is required. It is the petroleum, however, that keeps out the wet. It is this that makes so many cloths now exhibit the powers of the duck's back. Wool, cotton, silk, linen, velvets, braids and even ship's sails are thus wrapped in an invisible film of rock oil.

PULSE CONTROLLER FOR OPERATIONS.

A French surgeon has invented an instrument which shows plainly the condition of the pulse in a patient while under the influence of chloroform or other anesthetic. The importance of a most careful watch of the pulse under such circumstances is well



Instrument that Registers the Pulse Beats

understood by the medical profession, one doctor doing nothing else during the operation. The instrument is said to be much more reliable than the fingers which lose their delicate sense of touch during a long operation. The instrument registers on a dial with a pointer which moves as the pulse rises or falls.

Enables One Man to Lift Tons

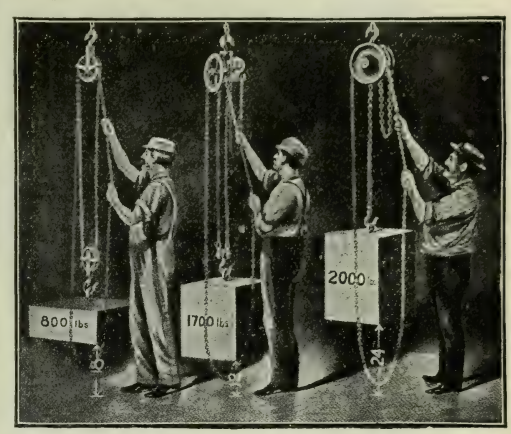
Block Added to the United States Army Equipment Would Make Any Person as Strong as Samson

Triplex Block

Nearly any man can be a Samson in this day of American mechanism. A little man weighing not more than 130 pounds can now lift a weight that would have strained Mr. Samson with all his long hair and muscles. Lifting a ton with one hand is no trick at all for a man of today when aided by a chain block that has just been added to the equipment of the United States army for serving heavy ammunition in the coast defense magazines. This lifting block, which because of its wonderful powers is attracting great attention in America and Europe, is to the man of today what the whiskers were to Samson. With it he is a giant. Without it he is no stronger than any other man. Thus in the 20th century machinery has enabled all of us who desire to become giants.

The block is triple geared, having the equivalent of three parallel shafts connected by power multiplying gears and giving nearly three-fold the efficiency of other blocks. It is hence called the "triplex block." The feats of lifting that can be performed by this simple little machine are almost beyond belief. With the triplex one ton block one man can lift a ton a foot in half a minute by pulling only 82 pounds. Thus in lifting the ton weight the strain on him is no greater than if he were lifting 82 pounds. Ten tons can be lifted by pulling only 140 pounds and 20 tons by a pull of 280 pounds. In lifting one ton the man handles 31 feet of chain; in the 10 and 20-ton lifts, 210 feet are handled. The ponderous mass of rope, tackle, jacks, skids, crow bars and rollers formerly employed in lifting great weights are done away with in the triplex and its kindred machines, called the duplex and the differential.

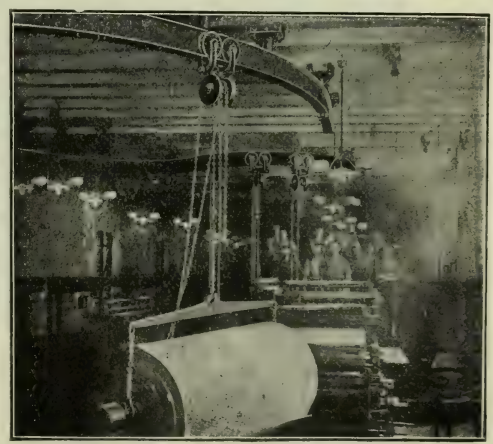
In its standard form the triplex is a portable machine intended to be hung by its hook to some overhead support, either fixed or movable, but it is also arranged to attach to a trolley intended to travel either on a crane or on an overhead tramway. It is thus available as the hoisting device in almost every type of machine for the handling of material, and has long been in service in many factories and other commercial establishments.



Differential Duplex Triplex

The picture shows the weight and height a man can lift in half-a-minute with one ton blocks. To lift a ton a foot: With the Differential three men can do it easily by pulling 216 lbs. and overhauling 30 feet of chain; with the Duplex one man does it by pulling only 87 lbs. but overhauling 59 feet of hand-chain: while with the Triplex one man pulls 82 lbs. and handles only 31 feet of chain.

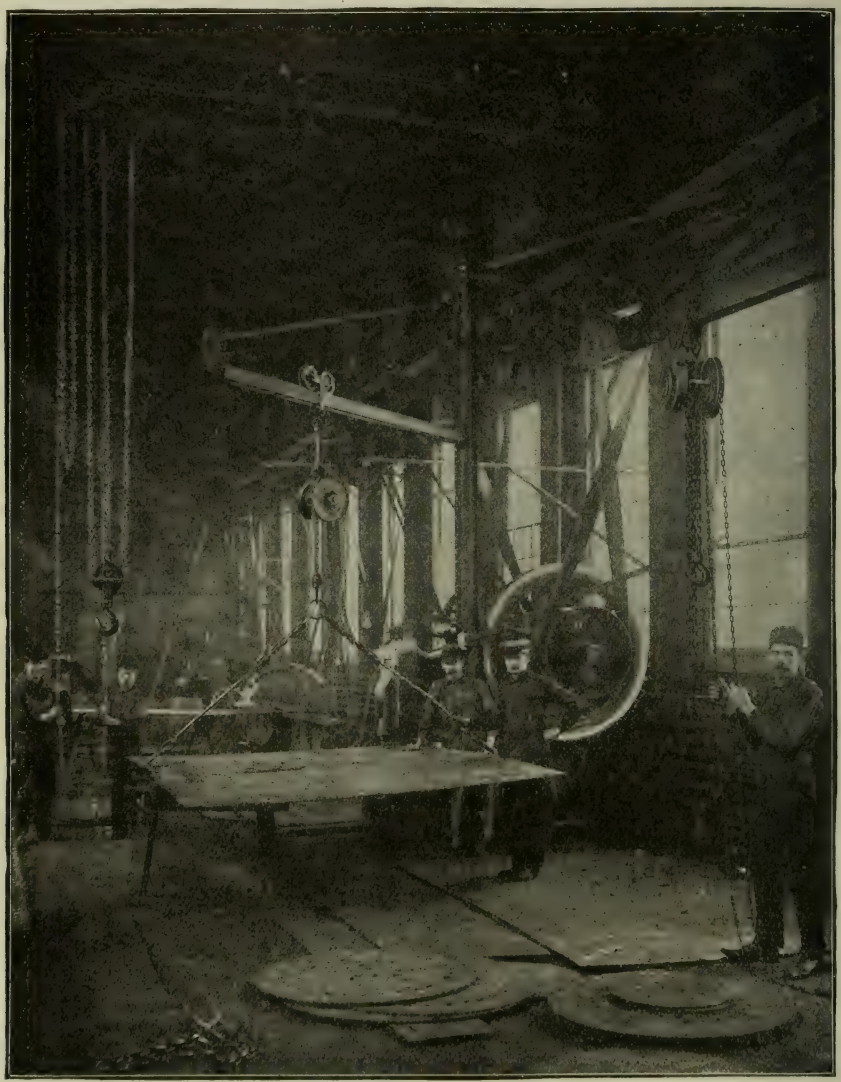
Prof. R. H. Thurston, formerly of the United States engineering corps and author of "A History of the Steam Engine," in describing this new addition to the army



Switching a Paper Roll

states: "The triplex block has a simple and triple train of spur gearing and thus develops remarkably high efficiency, so that it becomes impossible to rely upon friction to

sustain the load. For this a separate and simple device is introduced. This independent sustaining mechanism automatically holds the load safely and yet enables it to be lowered with slight effort and at high efficiency. A new and independent device is introduced to control the lowering, this device causing no friction in hoisting and being perfectly reliable and effective for its purpose."



Corner of Boiler Shop

Scene in the Shop of the Lidgerwood Manufacturing Co., builders of hoisting engines, who handle the entire output in the machine and erecting shops, and ninety per cent in their boiler shop, by means of Triplex Blocks

velocity, but without increasing the danger. The secret of its success is that instead of relying on friction to prevent the load from running down, the triplex is designed to reduce friction, both in hoisting and in lowering and to obtain the highest

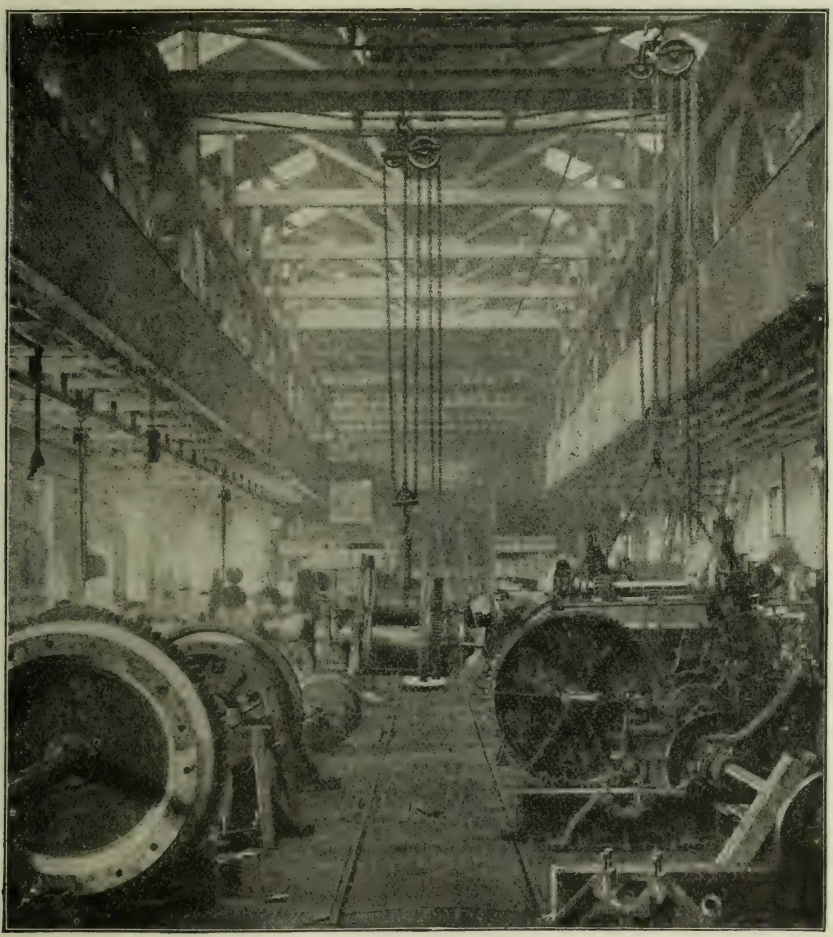
The triplex block, with its independent and automatic sustaining device, is said to attain an efficiency of more than 79 per cent.

The hoisting mechanism consists of a direct train of spur gears from the small pinion on the central shaft to the internal gear

wheel cast within the main frame. The two intermediate gears between the pinion and the internal gear are carried on the circular frame or cage and roll around within the internal gear, thus forming a sun and planet motion giving the desired leverage.

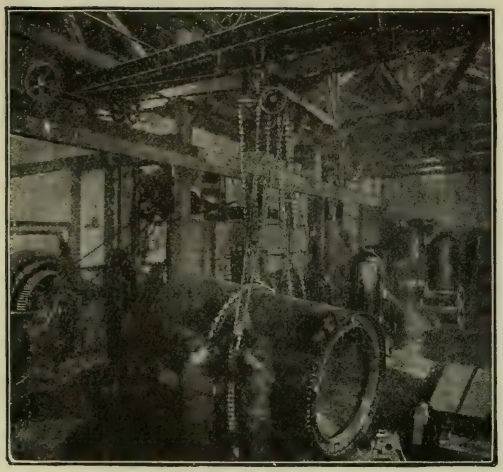
The great advantages of the double arrangement of intermediate gears are balanced journal pressures, increased wearing surface, subdivision of strains and accurate equalizing of the load, resulting in diminished friction and wear. The frame carrying these intermediate gears is keyed fast to the hub of the hoisting chain sheave, and the central pinion shaft is driven by the hand chain wheel so that the power is transmitted from the handchain to the load chain through a direct spur-gear train of high efficiency.

The sustaining mechanism at the hand chain end of the block consists of a set of discs, one of which has external ratchet teeth engaging with a drop forged pawl. The hand chain wheel is screwed upon the central spindle and clamps the discs tightly to the shaft in hoisting, or if the shaft tends to revolve under the pull of the load. The parts thus clamped together act as one, and the ratchets offer no resistance in hoisting. When the direction of the hand chain wheel is reversed in lowering, it unscrews, the ratchet disc being held by the pawl, and the load is lowered against the friction of the discs under control of the hand chain, the stoppage of which causes



Erecting Shop

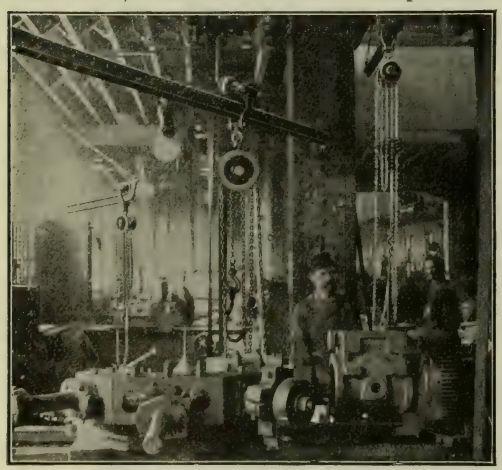
The center bays are covered by traveling cranes equipped with 5-ton Triplex Blocks, Individual machines are served by smaller Triplex Blocks, suspended on trolleys, or on light jib-cranes swinging from the columns, which support the traveling cranes.



Lifting a Boiler Suspended from I Beams

the discs to tighten and sustain the load perfectly.

In the 12, 16 and 20-ton sizes an important



Making the Triplex Do the Lifting

advantage is their two independent hand chains, which may be worked both together or one at a time.

STREET CAR CROSSING SIGNAL.

The street car lines of Dresden, Germany, are equipped with a signal system warning teams and pedestrians when the car is approaching across street. A box two feet long is suspended in the middle of the street above the car tracks, and when the approaching car is within half a block, a bell rings and the word "Halt" shows in red letters. The signal is worked by electricity, and the lights go out as soon as the car passes.

AS TO WAR VESSELS ON THE LAKES.

Old Canadian-American Treaty Held Obsolete and Void—Many Lake Ships May Appear

Two new cruisers are soon to be ordered for Canada, one for service on the great lakes, and one for service on the Canadian Atlantic coast. The one for the lakes is to be of 540 tons burden, 167 feet long and 22 feet deep. It is to have high speed and is to take the place of the present slow vessel built for service on the upper lakes under the agreement of 1817.

This agreement, which was made between the British minister at Washington and Richard Rush, acting secretary of state, April 28, 1817, provided that the naval force to be maintained on the lakes by the United States and Great Britain should be confined to the following vessels on each side: "On Lake Ontario, one vessel not exceeding 100 tons burthen, armed with one 18-pound cannon; on the upper lakes, two vessels of like burthen and armed with like force, and on Lake Champlain, one vessel similar to that on Lake Ontario and armed in the same way."

This agreement has been modified to meet changing conditions, the old cruiser Michigan having a displacement of 685 tons and carrying six guns, but Canada has clung to the limitation as to the number of vessels, and recently has shown opposition to the establishment of the proposed naval training station on Lake Michigan. The suggestion that training ships be maintained on the lakes by the United States and Canada has also met with opposition, the Canadians protesting against what they speak of as the treaty of 1817.

The arrangement as to war vessels on the lakes was in no wise a treaty, but merely an agreement. The Under Secretary of State at Ottawa has recently directed attention to the fact that there is nothing in any existing arrangement limiting the number or armament of ships which either the United States or Canada may maintain on the lakes. He believes that the agreement of 1817, with its provisions for obsolete vessels, is not binding and is voidable by either party on six months' notice.

This, the American authorities, too, believe, is correct, and if Canadians wish to abrogate the agreement of 1817 the United States is ready. Meantime the naval station will be established on Lake Michigan.

MECHANICS FOR YOUNG AMERICA

How To Make Your Own Fishing Tackle

Hurrah! it is fishing time. In April the fish bite better and they taste better than in any other month. So get out your fishing tackle, boys, and ho for the lakes and streams. This year don't spend so much of your parents' money for fishing paraphernalia. Make it yourself and you will feel prouder of it and the old folks will feel prouder of you, and you will be the envy of all the boys around.

If you want to fish and engage in some other sport at the same time, you should by all means have a fishing semaphore. This instantly shows from a distance when a fish is on the hook, and any boy can make it. The line may be baited and set, and the fisher can give his attention to other things, with only an occasional glance at the signal. To make the semaphore take a piece of board about 12 inches square and 2 inches thick. If a single piece cannot be obtained, build a block of this size out of small stuff. Bore a hole in the center one inch in diameter and in this drive a scantling 2 inches square, 12 or 15 inches long and pointed at the lower end. Now take a piece of wood 2 inches wide and 5 inches long for the semaphore and round two of the corners, as shown in the cut. Bore a small hole 2½ inches from the tapered end and fasten the board to the scantling by driving a small round nail at A (Fig. 1). Drive another nail at B, leaving the nail head protrude one-half inch from the scantling to serve as a rest for the semaphore. The board should be made to turn easily on the pivot nail. At C fasten a strip of thin sheet iron, bent flat at the top, so as to support the semaphore in place when it is sprung—that is, when it raises to indicate a fish is caught. The free end of this strip or spring rests on the outside of the semaphore when it is down, and supports it when it is up. It should not press too tightly against the signal. At D drive a small nail and attach the fishing line. When the fish takes the hook it will throw the signal up to a horizontal position and the spring C will hold it there. The semaphore may be painted red, or white, or to bear the word "Fish."

In the January issue of Popular Mechanics were described methods of winter fishing that may very easily be applied to spring and summer fishing, with slight alterations which any boy with a bit of mechanical ingenuity can figure out for himself. For instance, the "jumping-jack" fisherman can be built on a big floating board with a 2-inch hole under the jump-

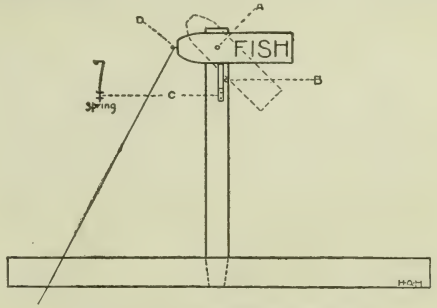


Fig. 1.—The Fishing Semaphore

ing-jack for the line to pass through, just as easily, if not easier, than on the ice. The "tip-up" is also of great amusement in spring and summer, and can be erected by aranging the "tip-up" between two logs or heavy timbers.

Bass and pickerel have an irresistible hankering for bait on a hook trolled by toy boats. These boats serve the purpose, however rudely made, and one boy can operate a whole fleet of them if he have a large boat by which he can row to any one of the small boats immediately when he notes a fish is hung. The boats can be made of a piece of plank, say 2½ feet long. The board should be sharpened at one end and rigged up with a couple of cloth masts (Fig. 2). The most important part of the craft is the rudder. This should be very long, to prevent the boat from making lee way and to keep it from changing its course. Drive a couple of nails in the stern of the boat, to which tie the fish lines, hooked with spoon or live bait. The small boat does not

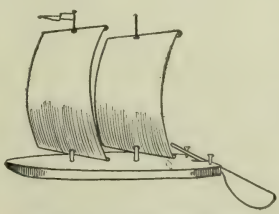


Fig. 2. Toy Fishing Boat

scare the fish as a large one does, and the bait pulled along by it is wonderfully attractive to members of the finny tribe, especially when trolled before the wind.

If proper fishing tackle is not accessible, it is very easy to manufacture it yourself.

Fig. 3.—Method of Making a Trout Rod

To make a trout rod first secure a long, straight, elastic pole, such as can be found in nearly any wood. Then secure some pins and a small piece of wire. File off the heads of the pins and bend them in the shape of the letter U and drive them in the rod on the same side at regular intervals, beginning at about 2½ feet from the butt end of the pole. Drive the pins just far enough in to permit the line to pass freely under the loop. To make the tip bend a circular loop in the center of a piece of wire and knot or bind the wire to the end of the pole, as shown in the illustration (Fig. 3). If you have plenty of wire, it will make better loops than the pins. Cut the wire into short pieces about 3 inches long, loop each piece in the center. Then with more wire or with strong, waxed thread bind the ends lengthwise on the rod, as shown in the illustration (Fig.3). After the binding is secure, twist each loop around to its proper position.

A large wooden spool, an old tin can and a thick wire will serve to make an A 1 reel. Run the wire through the spool and

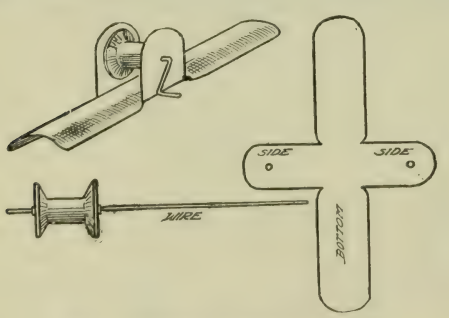


Fig. 4.—Method of Making the Reel

wedge it tightly so that one inch protrudes at one end and three inches at the other. From a tin can cut a piece of tin of the shape shown in Fig. 4. Two protruding parts are left on each side to be bent up for side pieces, to serve as rests for the axle tree. After the side pieces are bent up in the proper shape, punch a hole in each and insert the ends of the wires through the holes. See that the spool revolves freely, and then bend the long end of the wire in the shape of a crank. Hammer the tin over the rod until it takes the exact curve of the rod and fits snugly. Then bind it firmly to the rod with strong twine. It is difficult to make a fish hook, though many good perch and cats have been caught with bent pins. A strong steel wire can be bent and filed to a point and a notch filed above the point for the barb. Fish hooks have been made of birds' claws. The claw is bound to a piece of shell by vegetable fiber. None of these home-made hooks are satisfactory, however, and it is better to carry a good supply with you.

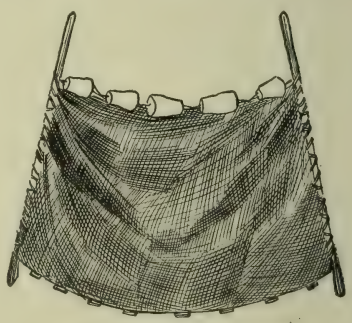


Fig. 5.—Simple Minnow Net.

Inside the hat band is a good place to carry small hooks.

Live minnows are the best bait for black bass, pickerel and many other kinds of fish, and to catch live minnows you need a net. One of the simplest minnow nets is made by fastening two sticks to the ends of a stout piece of mosquito bar. If desired, the net may be provided with floats at the top edge and sinkers at the bottom, as in the illustration (Fig. 5). Old sieves and pieces of meshed wire can often be transformed into ideal minnow nets.

A good landing net may be made from a forked stick and a piece of strong mosquito bar, or preferably a ball of twine. Bend the two ends of the fork until the ends overlap each other and bind them tightly together, as shown in the cut (Fig. 6). Waxed twine serves best in all such binding work in making reels, nets and other tackle. Now, if the net is to be made of mosquito bar, sew the mosquito bar into the shape of a bag and fasten the mouth to the sides of

the loop described by the connected forks of the stick. A better net is made from twine. Fasten the pole in a handy place, with the hoop suspended vertically a little higher than your neck. Cut a number of

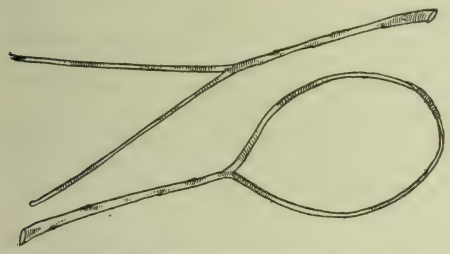


Fig. 6.—Frame for a Scoop Net

pieces of twine each about eight feet long. Double each piece and slip it on the loop with the loose ends hanging down. Arrange the double strings this way all around the loop. Now begin from a convenient point, take a string from each adjoining pair and make a simple knot of them, as shown in the diagram (Fig. 7). Continue all the way around the loop, knotting the strings together in this manner. Now begin on the next lower row, and so on until a point is reached where you believe the net ought to commence to narrow or taper down. This is accomplished by knotting the strings a little closer together and cutting off one string of a pair at four equidistant points in the same row. Knot as before until you

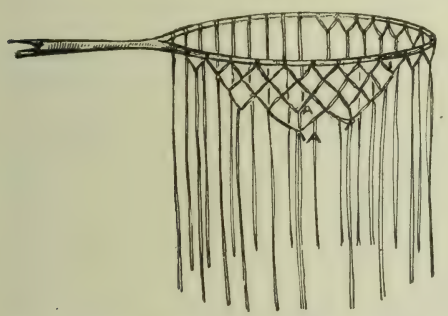


Fig. 7.—Showing Method of Weaving the Scoop Net

come to a clipped line; here take a string from each side of the single one and knot them, being careful to make it come even with others in the same row. Before tightening the double knot pass the single string through, and after tying a knot close to the double one, cut the string off close (Fig. A).

Continue as before until the row is finished, only changing from the first plan when a single string is reached. Proceed in the same manner with the next and the next rows, diminishing the number of strings remaining until the remaining ones meet at the bottom. Be careful not to let one drop mesh come directly under another of the same kind.

A bucket or old tin can with the top and sides perforated by means of a nail and hammer (Fig. 8), will serve as a minnow bucket. The illustration (Fig. 9) shows the proper way to bait a hook with a live minnow. The cartilaginous mouth of the minnow has little or no feeling in it, and when thus baited the minnow is not killed and swims about promiscuously, thus standing a much better chance of catching

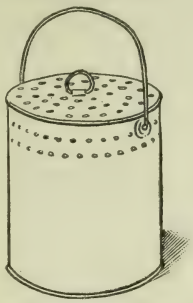


Fig. 8.—Minnow Bucket

Fig. 9.—How to Fasten a Minnow on a Hook

a fish than when cruelly mangled by the hook of the ignorant fisherman.

BRITISH SAFETY-LAMP DEVICE.

A recent English invention is believed to give absolute safety to oil lamps. The device consists of a circular metal box in the bottom of which is a deposit of salt over which is placed a layer of specially prepared cotton waste. Running through the waste is an asbestos wick, woven by hand. The box, which is pierced with numerous small holes, is then immersed in the oil until the cotton waste will absorb no more. The box is then wiped dry and is ready to use. The lamp may be overturned or thrown about with perfect safety. The device is adaptable to all kinds of oil burning lamps, and is said to yield more light from the same amount of oil.

Navigation on the great lakes will open late this year. In January Lake Michigan was frozen from shore to shore and even now at points on the west shore the pack ice is piled up 40 feet deep from the bottom.

Wireless Telegraphy For 1904

Signor Marconi Talks of His Plans and Improvements Being Made

BY GUGLIELMO MARCONI.

What are the prospects of wireless telegraphy for the ensuing year? It is a big question and an indefinite one. It must be remembered that wireless telegraphy is yet only in its infancy. To some extent it has emerged from the experimental stage—that is, over certain distances it is an actual practical working system—scientifically and commercially perfect. In overcoming long distances its practical utility has also been demonstrated, but it has not been able so far to justify itself on commercial grounds. That is what I mean when I say it is only in its infancy.

I know from my own experience, from my own positive knowledge gained by incessant labor, that the transmission of signals across the Atlantic is thoroughly practicable. It has been done and it is being done and in the approaching year I have every reason to believe that I shall be able to maintain a full and efficient service between Great Britain and the United States.

My continuous experiments and the improvements I have made in my apparatus warrant me fully in making that prophecy, and I do not usually prophesy unless I know. There are many doubters and skeptics, rivals and others who have poo-poohed its practicability for trans-Atlantic messages—well, before 1904 is out they will be sorry they spoke.

At the present moment we are negotiating with the United States government for the establishment of wireless communication between the American continent and the Philippines and in the event of the United States acquiring new colonies—for you are an expanding power now, you know—we shall hope to be permitted to establish our wireless system there also.

Not only do we work forward with confidence to establishing wireless communication on a commercial basis between Great Britain and the United States, but also between the United States and the continent of Europe. I do not want to expatiate on the advantages it will be to the world's commerce and thought when this cheap and perfectly reliable, if invisible, method of communication is established between the new world and the old. Its results cannot fail to be great. I might be justified in using a bigger word, but prefer to await the justification of events.

Our next important experiment will be the connection of Italy and South America by the wireless system. It is a distance of 6,500 miles, nearly double that to America from London, and I may say we are as certain of success in this as over the shorter distance. The Italian government is offering us every assistance, facility and encouragement in setting up this installation and is perfectly satisfied, moreover, with the proofs we have furnished of the progress we are making.

At present we are working for the British admiralty on wireless communication between London and Gibraltar. It is proving most successful and of the 1,000 miles 500 is over sea, while 500 is across the Spanish peninsula. There is no interference with our signals over that distance, and one of the most important developments of the near future will be the absolute security with which we can transmit over any distance without any possibility of interception or interruption, whether accidental or designed.

I need not dilate on the uses to which our system has been adapted on ships. Over 100 ships are now equipped with the Marconi apparatus, sixty of them warships, the others being trans-Atlantic and other liners. I know that the installation is immensely appreciated by the ships using it, and before long the big vessels of the White Star line, including the Cedric, following the example of Cunarders, will be fitted with our apparatus.

Did you notice that Popular Mechanics was the first to give the inside history of the Japanese-Russian controversy; telling how England was the real instigator of the trouble, and how London colored the press reports sent out to all the English speaking people in order to create the kind of public sentiment England desired? Did you notice that Popular Mechanics in recounting the Iroquois disaster said that the destruction of a few skyscrapers would be necessary to cause more substantial structures of this kind just as the destruction of the Iroquois was necessary to cause more substantial theatres? Well, Baltimore has since burned, skyscrapers were destroyed and the result will be better buildings of this class. There is always good and important information in Popular Mechanics.

Railroad To Mohammed's Shrine

American Company Building the Rails for the Line from Beirut to Mecca

The Maryland Steel Company has been awarded the contract and has begun work upon the steel rails for the Hamadie du Gedjaz railroad which will run from Beirut, on the Mediterranean coast of Turkish Asia Minor, to Mecca. The rails will be laid down at Beirut at $22.88 a ton, although they are the same rails that are sold to American roads at $28 a ton on board the cars at the factory. It is fair to assume that even at the lower price the company makes a profit.

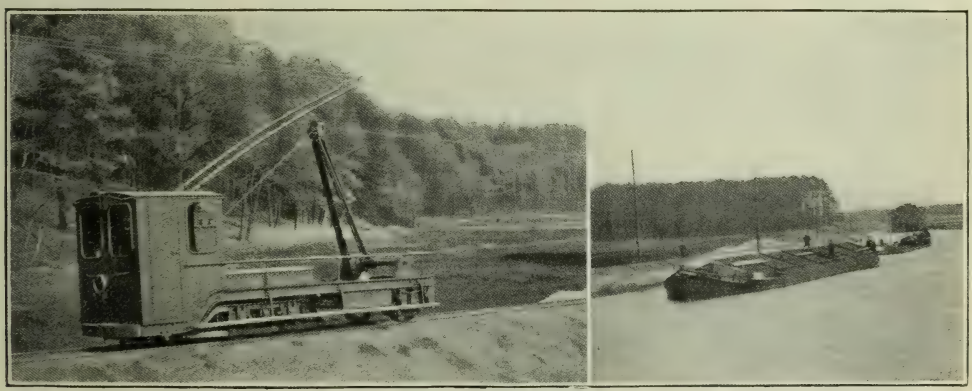
The completion of the road will work some significant changes. It will be interesting to note whether the pilgrims by foot or by canal to the tomb of the prophet will rapidly decrease and transportation by railroad take the place of the long and laborious pilgrimages which have been made for centuries.

The only element of uncertainty is that down to the present time this pilgrimage has imparted a kind of "odor of sanctity" to the pilgrim and the longer and more difficult the pilgrimage the more of loyalty to Mohammed was considered to be displayed, and the higher the Hadji's reputation for piety rose among the "faithful." The iron horse must bring with it occidental influences, comforts and customs, and it is fairly to be presumed that by degrees more and more Mohammedans will make their pilgrimages by train to the shrine, thus saving time, money, fatigue and trouble.

It is also hoped that the completion of the road will remove one source of danger to the eastern world—that caused by the filth of these pilgrims. In a multitude on pilgrimage they are indescribably filthy and the result has been that their loyalty to their faith has been the cause of thousands if not millions of deaths and has imperiled other parts of the world.

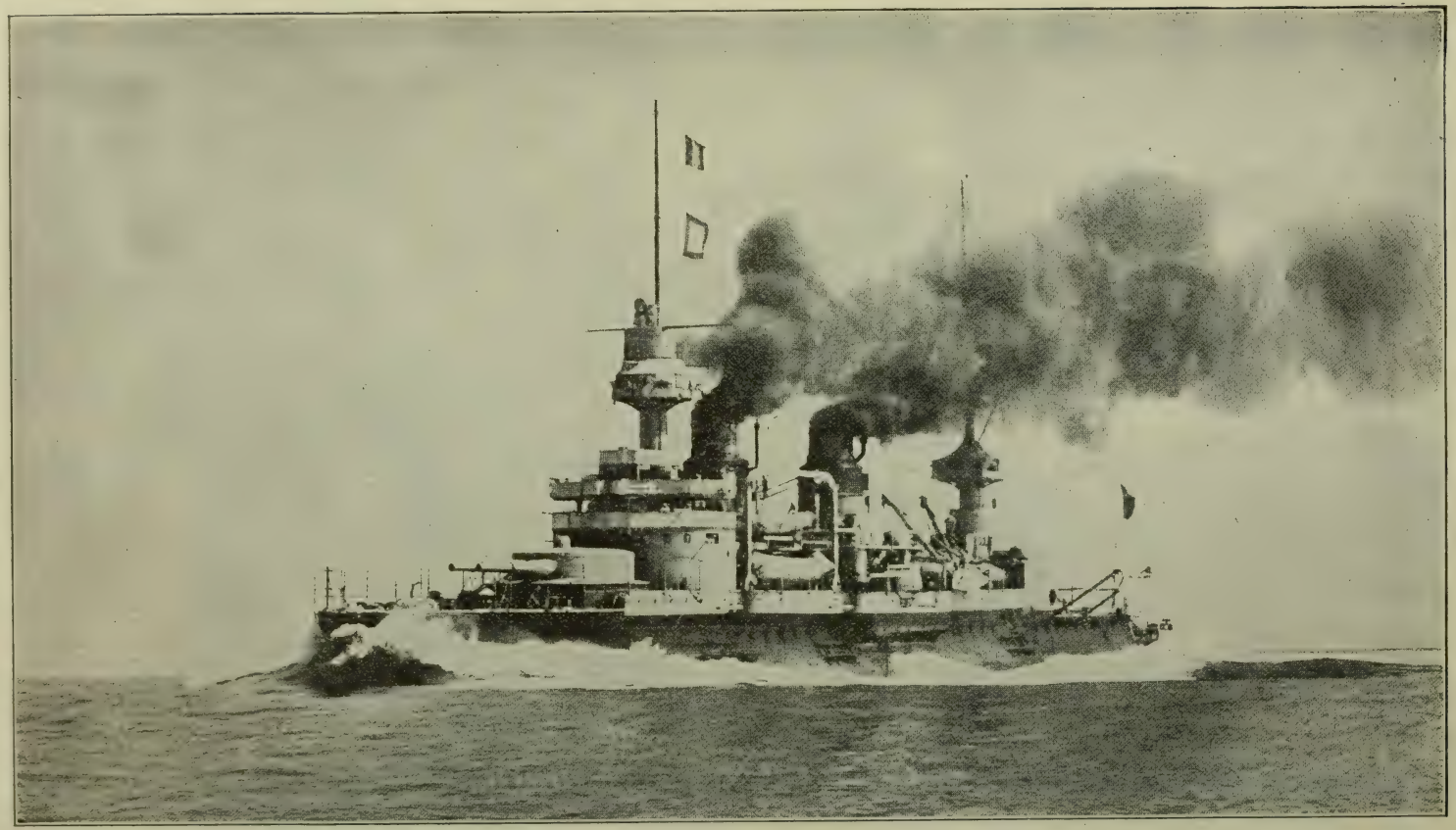
THE ELECTRIC "CANAL MULE."

The system of hauling trains of canal boats by means of an electric locomotive as employed on the Miami and Erie canals between Cincinnati and Middletown, mentioned in the March issue of Popular Mechanics, marks a new era in canal traffic. The method is the same as is employed on the Tetlow canal of Germany. The power for the electric motor is obtained from generating stations, the current being conveyed by overhead wires. The locomotive has been referred to in Popular Mechanics as the "electric canal mule," in that it supplants the old system of canal haulage that was rapidly decaying before the onward progress of steam and electric transportation. The electric canal haulage, however, promises to revive the importance of the canal and to greatly increase the amount of canal traffic. Trains of boats, often numbering as many as ten or more, are hauled through the water by an electric towing locomotive which runs along the canal bank. The application of electricity for this work paves the way for the electrification of the enlarged Erie canal in New York, as well as of other canals.



Towing Boats by an Electric Motor on the Tetlow Canal Near Berlin.

New Pride of the French Navy



THE FRENCH BATTLESHIP, ST. LOUIS, is the newest and most formidable addition to the French navy. The St. Louis is a battleship of the first class, of 11,275 tons' capacity, and of 14,500 horsepower. She has a speed of 18 knots. The official description of the boat, contained in the Journal of the United States artillery, gives the following data:—Armor protection· Water-line belt, 15.7 in.; tapering to 10 in.; upper belt, 3 in.; turret, 15.7 in.; armored deck, 3.5 in. Armament: Four 12-inch guns in turret, one forward and one aft; ten 5.5-in. quick-firing guns; twenty 3-pounder quick-firing guns; four 1-pounder quick-firing guns; and thirteen machine guns; with four torpedo tubes (two submerged).

The Future of Radium

By M. Pierre Curie

It is quite difficult to predict the future of radium, but I believe its field will be in the domain of medicine, rather than of warfare and commerce. A physician with a tenth of a grain of radium could receive an unlimited number of patients and probably effect cure after cure in cases of lupus and cancerous affections. The scope of radium is naturally affected by its enormous cost, as an ounce is worth a king's ransom. Recently, however, I received a communication from a firm in Buffalo, N. Y., claiming to have a new process of extracting radium from uranium, which may cheapen the article.

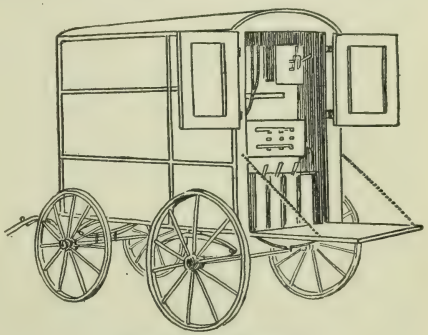
Radium might be a factor in warfare in the way of producing explosives in a magazine, causing the disappearance of the ship and the entire ship's company. But radium is dangerous against individuals rather than objects. A tenth of a grain left contiguous to a person is capable of producing complete paralysis. For this reason it would prove a dangerous medium in causing crime which would defy detection, if it ever become as easily obtainable as other chemicals. It is also dangerous to bring a tenth grain in contact with a highly charged electric battery, because an immediate explosion is certain. At first we hoped that the blind would be benefited by it, for a particle of radium inclosed in a box, placed on the forehead, conveys a sensation of light to the eye. But we found it did not enable the blind person to distinguish objects. So far we have only used radium salts, and in minute quantities, yet the remarkable results produced show the possibilities of the pure product are inestimable.

A man entering a room where there is a pound of pure radium would perish, but there is no fear of this, as only radium salts are yet obtainable from the barium found in Bohemia called pitchblende, of which a ton often yields less than a gram of radium salts. Already the mineral of Jachimsthal, which gave my wife and myself our first material, is exhausted, and only the discovery of a veritable Klondike of radium will demonstrate the wonderful force of this chemical so little understood even by its most ardent investigators.

Before doing what Prof. Gustav Lebon has suggested, the blowing up of magazines, forts and arsenals in the enemy's country by using a small tube of radium, we shall have to find the requisite amount of pure radium. Its potentiality is wonderful, and I can even perceive a radium cannon projecting electric shocks at great distances with deadly effect.

PORTABLE SUB-STATION.

The electric company at Sheffield, Eng., have provided some portable sub-stations which can be drawn about by horses. In this station is all the machinery and switchboard for supplying a single or two-phase current at 400 or 200 volts. The portable



Portable Transformer.

station can be connected up in a short time, and is especially convenient for emergency or temporary requirements. The arrangements seem odd to us in that the outfit is not moved by an electric truck instead of horses. The Electrical Review, London, says: The whole apparatus can be drawn about by horses, deposited in a convenient spot, and connected up in a few hours to supply any temporary demand, such as an exhibition, construction works, or permanent consumers during the erection of a district sub-station, to which the load can be changed over on completion, and the van moved on to some other sphere of usefulness.

When trolley cars took the place of mule cars in the city of Mexico they brought to an end an old-time custom. Formerly when a Mexican left a car he felt obliged to shake hands with every one he knew on the car. Every time the car stopped the process was repeated and the result was the journey was a tedious one. When the trolley cars were put in service an order was issued not to wait for formal leave takings.

May Dispatch Letters and Parcels by Wire

The "Electric Post" Threatens an Upheaval in Present Methods of Mail Delivery

The "electric post," which may be the means of transmitting letters and parcels along electric wires at a speed of 250 miles an hour is being promoted in England. American capitalists have their eyes on the venture and it may not be long before we are sending and receiving letters and packages by electricity between the principal cities of the United States. Many in England believe the "electric post" will prove the most important mechanical development since the first railway was built; that it will soon do away with railway mail trains, letter carriers, sorting clerks, etc.

The "electric post" is the invention of Count Robert Piscicelli Taeggi, of Naples. He has already formed a syndicate of English capitalists in London for the purpose of establishing the system in Europe. The Italian government has granted the inventor a concession for operating the "electric post" between Naples and Rome.

The system is worked throughout by electricity. By its means a letter could be posted in Chicago and a reply received from New York in the same day. A St. Louis draper could place an order for light goods with a Chicago dealer and have the goods delivered before night; for the electric post can carry parcels as well as letters.

To better explain the working of the system, let it be supposed that the dome of the new Chicago postoffice is the central station of the "electric post" for service in the city of Chicago. From the top of the tower wires would converge in all directions, reaching throughout the city, supported at intervals by columns 50 feet high, called collecting poles. There would be a pole about every block along the principal business streets of the city. At the base of each of the posts there would be a box in which to post the letters. An automatic arrangement inside the box would deface the stamps on the letters, at the same time inscribing the latter with the number of the collecting pole and the date and hour of posting. Every five minutes there would be sent from the central station an empty box, with motor attached which would run on wheels along the wires. The wires would not only fill the same purpose as rails, but would act as conductors of the electric current to drive the motor. On reaching the first collecting pole the box would stop and open itself. At the same time it would cause the collecting box at the base of the column to run up the center of the latter and empty its contents in the receptacle provided. The motor box would then resume its journey, calling at each city pole in turn. Having performed its circuit the motor box with the letters would return to the central station. There the letters would be sorted and those for other cities would be placed in similar wheeled boxes and dispatched along the wires to their destinations.

Practically speaking the electric post is an electrical aerial railway, with letter boxes in place of carriages. Cities of the size of St. Louis, Boston, Philadelphia, Washington, Buffalo, Cleveland, Kansas City, San Francisco and New Orleans would be in direct communication with New York and Chicago. Smaller towns would be served from the nearest important center, to which letters would be transmitted in the first place. A great network of wires would be spread over the United States.

To avoid the possibility of boxes colliding while on their way, two sets of wires would be provided, one for the outward and the other for the inward journey. Boxes traveling in the same direction would be kept three miles apart by a "block" system. "The vehicles follow one another uninterruptedly," says Count Taeggi, "and obey, as it were, the word of command given them at the start."

The count has provided against the possibility of the mails being robbed while on their mid-air journey. Every supporting pole would be fitted with a fulminating ring, which he calls "the ring of death." Being connected with one of the high potential wires, this ring would inflict a fatal shock upon any stranger climbing to the top of the pole.

The count claims that the United States government would realize a great saving by the adoption of his system, for it would dispense with thousands of employes and many appliances, of which mail bags alone now cost the government many thousands of dollars a year.

Send for our premium list.

Train Carries Court House Bodily From One Town to Another

Spreads Wonderment and Consternation in Its Path as It Speeds Over Nebraska Plains

Here is a reproduction of a photograph illustrating how justice may be dragged about by a tool of the corporations. The locomotive is the "tool" and "justice" is the of the train, the caboose being about ten cars in the rear. This shipping of the court house bodily on a regular freight train is the result of a bitter fight between two rival

Court House in a Train Speeding Over the Plains in Nebraska

court house that the locomotive is hauling in Nebraska from Henningsford to Alliance, a distance of 20 miles. The Railway Conductor, an authority on railway affairs, calls it a case of "justice on wheels."

The Burlington train, hauling this courthouse was an object of great curiosity as it sped through the country without loss of time, and it is the first case on record where a building was shipped intact by railroad from one town to another. The court house, it will be noticed, is loaded near the front towns. Henningsford was the county seat and consequently had the court house until Alliance grew to greater size and power. Then came the tug of war. Alliance had the money and the votes and so was chosen as the county seat. Next followed the job of moving the court house. This, with modern methods, was regarded as an easier and more economical method than the building of a new court house in Alliance.

The court house was 40 by 50 feet, two

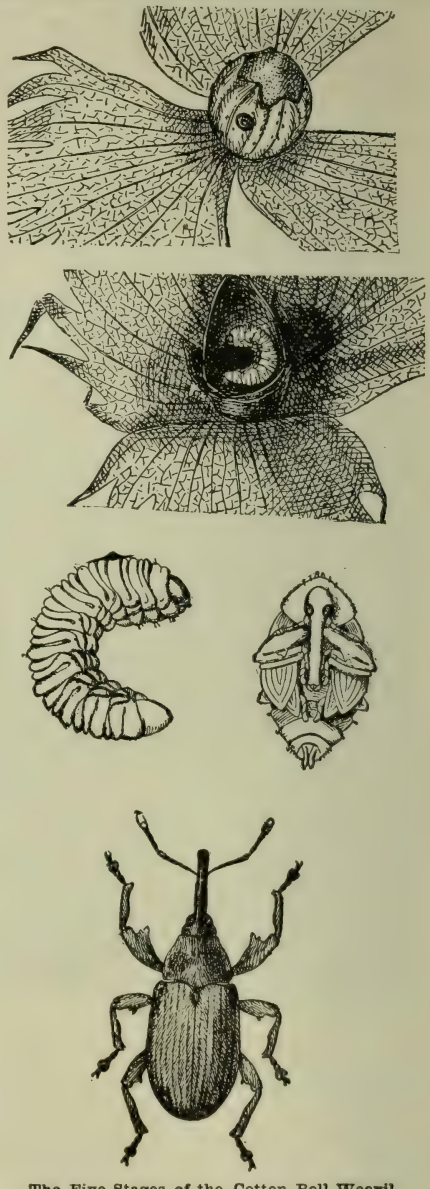
stories high, with heavy truss roof constructed with a heavy pine frame weighing 100 tons. A housemover from Lincoln contracted to move the building. He first started to perform the work by teams and rollers, but found that he could not thus complete the job in the allotted time and appealed to the railroad company, which came to his rescue. J. R. Phelan, superintendent of the road, intrusted the work to E. W. Bell, superintendent of transportation. The structure was loaded on four 50,000 pounds' capacity trucks. When ready to start the distance from the track to the top of the deck on the building measured 50 feet. Truss rods were made of 3x6 stringers over each truck. As a stand board to hold truss together 1x6 planks were used. To keep the building from rocking a set of double block and falls were secured to the top corners, brought down opposite each side and secured to 60,000 capacity coal cars loaded with coal.

From a distance the train looked as if it had run through the court house and was thus carrying it along wedged to the cars.

As the train with its court house swept along over the rails country folks ran out to see; cowboys rushed toward it on horseback; farmers left their plows and gazed long in wonderment; housewives called their neighbors; children rushed from the schools and the teachers went with them, and all along the trip the train spread astonishment and excitement in its path. Arriving in Alliance, the whole town with a brass band was in readiness to welcome it. A shout went up as the court house first of all was seen in the far distance winding its way along the plains. Nearer and nearer it came, into the station it rode and Alliance had a new building—a court house. A temporary track was built and the hall of justice switched to the site where it now stands. Long will the farmers, the Nebraska cowboys, the school children and the residents of the two towns tell of the day when the court house was shipped by freight from Henningsford to Alliance.

THE COTTON BOLL WEEVIL.

The cotton boll weevil is a destructive insect which made its appearance here in 1899, and caused a loss last year to the cotton planters of $15,000,000. Its ravages thus far are confined to the eastern half of Texas and a narrow strip of western Louisiana. The weevil egg is deposited in the cotton boll where it hatches in three days into a grub and begins to eat the cotton in the boll. In from seven to twelve days it grows to a length of about half an inch, when it spins a cocoon like the silk worm.



The Five Stages of the Cotton Boll Weevil

Three days later there emerges the adult weevil, which is a small beetle a quarter of an inch long with a sharp beak half as long as its body. With this beak it pierces the boll and deposits an egg, after which it dies. From egg to adult weevil takes only three weeks.

Great Buildings of America

The Railway Exchange of Chicago

Its white walls reaching 240 feet above the ground on the lake front, with 700 windows looking out on Lake Michigan, the new Railway Exchange, which has just been completed, is one of the pride mansions of "Chicago's front yard." This splendid structure was built by the united efforts of railways entering Chicago as their permanent home.

The building is 16 stories high with attic, making practically 17 stories. Its cost was $2,500,000. It covers a ground area of 30,000 square feet at the corner of Jackson and Michigan boulevards. The exterior construction is of white glazed terra cotta with bay windows from the fourth to the twelfth floor inclusive. Entrance from Jackson and Michigan boulevards lead into a magnificent rotunda finished in marble and mosaic. The central court, 60 by 70 feet, reaches to the 14th floor, above which level the space is extended to 89 by 91 feet. Corridor floors are of mosiac and the walls are wainscoted with marble up to the height of the transom.

An idea of the immensity of the structure can be obtained when it is stated that it contains 6,000 tons of steel construction alone. The building contains 350,000 square feet of floor space, divided in 1,200 offices. The building alone has as many occupants as there are inhabitants, including men, women and children, in a good sized town. Five thousand people work in its offices. There are 12 elevators. An engine of 1,000 horse-power furnishes power for the structure's various requirements. There are 6,000 electric lights, and electric bells innumerable. Two thousand windows furnish light by day, and entrance and egress is obtained by 1,500 doors. Burnham & Co., architects of the building, will have occupied their offices in the structure in 6½ months from the time of starting the mason work at the sidewalk line. The building was completed in three months from the time the foundation work began. There were times during the process of construction when two stories per week of the structure were completed.

The Railway Exchange Building, Chicago

WARSHIPS TO CARRY MODELS OF THEMSELVES.

The United States navy intends to emulate Germany in equipping all warships with miniature models of themselves. The kind to be provided for each ship is known as a supplementary plan or skeleton model.

At present many of the marines and even officers often have no conception of the hidden parts of vessels. The only ship that now has a skeleton of herself aboard is the turret ship Monterey, commanded by Commander W. H. Beehler, who was a naval attaché at Berlin for several years. The model can be taken apart and the men serving on the Monterey can look under the boilers at any time instead of having to wait until the fires have been drawn. This fact alone has saved more than its cost.

EASY ELECTRICAL EXPERIMENTS

A THERMO-ELECTRIC GENERATOR.

Thermo-electric generators are devices for transforming the energy of heat into electric energy. In their simplest form they consist of two dissimilar metals joined together at two points. If one of these junction points is heated so that its temperature is above the other junction, an electric current is generated, the electro-motive force of which depends upon the difference between the temperatures of the two junctions. Some metals give much more powerful effects than others. Antimony and bismuth wires, twisted together give the most powerful effects, but these metals are not easy to obtain. The amateur can, however, easily obtain iron and German silver wires, and by means of these may construct an electric generator which is capable of ringing an electric bell from the current derived from the heat of an ordinary lamp chimney.

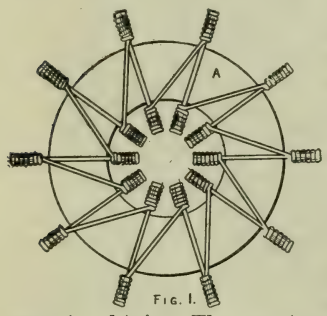


FIG. 1.

About sixty feet each of German silver and iron wires will be required, of about No. 14 B. & S. gauge. The exact size is not of importance, but the larger the wire the greater will be the current capacity of the apparatus. Having carefully straightened the iron wire cut off ten pieces each 3½ inches long. Also cut off ten pieces of German silver wire six inches long. Procure at a stove dealer's twelve pieces of heavy mica (commonly but erroneously called isinglass) of a size such that circles four inches in diameter may be cut from it. Cut out twelve mica rings like that such as A, Fig. 1, the external diameter being four inches, and the diameter of the hole two inches. Also, as an aid in construction, cut from a piece of ¼ inch whitewood a ring of the same size as the mica rings.

Using this wooden ring as a form, fasten upon it the ten pieces of iron wire, each piece pointing directly towards the center of the ring, the spaces between each piece being equal. Fasten the wires to the wooden ring by small wire staples. Then, taking the pieces of German silver wire, begin by twisting the end of the latter around one end of one of the projecting iron wires, clamping the apparatus in a vise during the process, and using a pair of pliers so as to make the twists very firm and even. Then twist the other end of this piece of German silver wire to the inner end of the next iron wire. Repeat this process around the entire ring, and the combination shown in Fig. 1 will be produced. After going completely around the ring the last piece of German silver wire should not be twisted to the first wire, but the two ends be left free for connections. The wires thus twisted may be removed from the wooden form, and should lie smoothly in place without springing or warping.

Proceed in a like manner to build up twelve such wire rings, each consisting of alternate German silver and iron wires. Although the efficiency of the apparatus depends upon all joints being very firmly made, yet, of course, it is understood that no attempt should be made to solder these joints, as the heat applied would melt the solder and ruin the apparatus. Each of the twelve units, when made, will constitute a source of electro-motive force, which may be treated in just the same manner as ordinary electric batteries. The units are piled one above the other, each separated from its neighbor by one of the mica rings first mentioned, and then the whole must be firmly fastened together by some convenient means. One method of doing this is to place on the top of the pile of rings two or three extra mica rings, and then by means of small bolts the whole can be tightly clamped together into one rigid body. Of course, it is understood that before they are finally fastened together the German silver terminal of one of the units is to be joined to the iron terminal of the next unit above, and so on until the top is reached. This will leave the iron terminal of the lowest coil and the

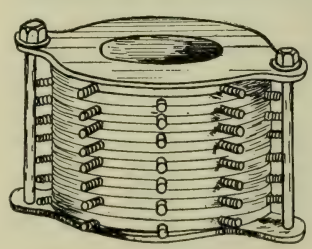


FIG. 2.

German silver terminal of the upper coil as points to which we may connect an electric circuit.

To generate electric current by means of this apparatus it is necessary to heat one set of junctions—as for instance, the inner terminals—so that the temperature of these terminals is higher than the temperature of the outer terminals. As has been stated, the value of the electromotive force developed, depends upon the difference between the temperatures of these junctions, so that it is of no use to heat both. On the contrary, if some means could be devised to keep one set of junctions at a low temperature, the efficiency of the apparatus would be much increased.

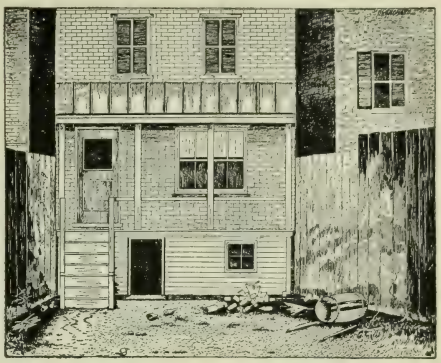
The apparatus as complete in Fig. 2 works very nicely when the inner terminals are heated by placing them directly over an ordinary lamp chimney. Some sort of a support can easily be made by the amateur so that the apparatus may be held close to the chimney without resting upon the latter. The inner terminals are then intensely heated, while the outer terminals are comparatively cool. The apparatus as described will deliver a current of one-third ampere, at a pressure of 1 volt, and unlike the current furnished by electric batteries is perfectly steady for any length of time. A battery of four or five of these generators each with its corresponding lamp would be capable of running a small motor.

If the workshop of the amateur is provided with a gas jet, more powerful effects may be obtained than by the use of the heat from a lamp chimney. The objection to the latter is that the outer terminals cannot be kept cool. With a small gas jet, whose heat is concentrated at the center of the apparatus, this objection is partly overcome. Care should be taken, however, that the gas flame does not play directly upon the twisted junctions, as, if it does, the latter will soon be oxidized, and the apparatus rendered unfit for service. A small spirit lamp burning wood alcohol, may be used. As a shield to prevent direct contact between flame and wire, small pieces of mica furnish the best material. Also, if difficulty is experienced in keeping the various joints from touching each other, strips of mica laid between the wires, and clamped in place, will be found very effectual.

Every mechanic can earn something that will be of great advantage to him in his business. Very little effort required. Write to Popular Mechanics for details.

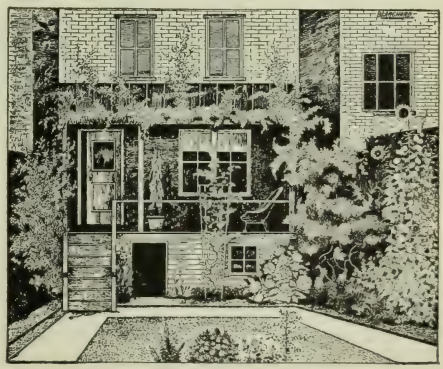
HOW TO BEAUTIFY THE BACK YARD OF A CITY HOUSE.

The back yards of city houses are, as a rule, as dismal and uninviting as possible. They are a dumping ground for old barrels, tin cans and other rubbish, and the



Before Beautifying

people living in the houses do not believe the yards could be made attractive. It is an easy thing to do, however, as the department of agriculture has shown in its interesting bulletin No. 185. The two illustrations tell the story; the selection of vines and plants is left to the individual choice of each person, and can be varied to suit the climate. The transformation can only be realized by an actual experiment.



What Vines and Shrubbery Will Do

Fathers who want to furnish a pleasant pastime for their children cannot do better than invest in a few packages of seeds the cost of which is trifling. The pictures are from photographs of the same yard taken before and after planting.

SHOP NOTES

THE EVOLUTION OF THE BELLOWS.

The great blowing engines of our modern blast furnaces, requiring hundreds of horse power and running constantly night and day, are but the outcome of the ancient method of blowing employed by the Egyptians 1500 years before Christ. The Blacksmith and Wheelwright has gathered data on the subject, from which we condense the following:

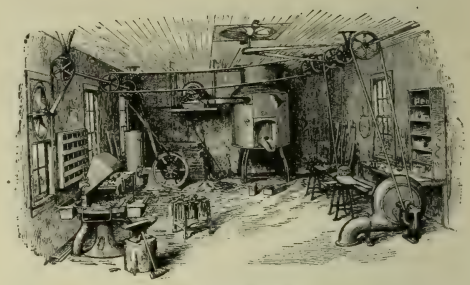
Figs. 1 and 2

In Fig. 1 is seen the Egyptian bellows, worked by men who rested their weight first on one leather bag and then on the other. Cords were used to lift the bag for another compression. The middle man is holding the rod of metal in the fire.

The Roman lamp bellows is like those still in use in this country and elsewhere. The same type of bellows, only larger, was used in pumping water, as shown in Fig. 3. The natives of British India still use the crude bellows seen in Fig. 4, for blowing charcoal fires for smelting ore. In striking contrast to all these is the scene of a modern blacksmith shop where power blowers are employed for forging, melting and ventilating.

Fig. 3.

Fig. 4.



A Modern Shop

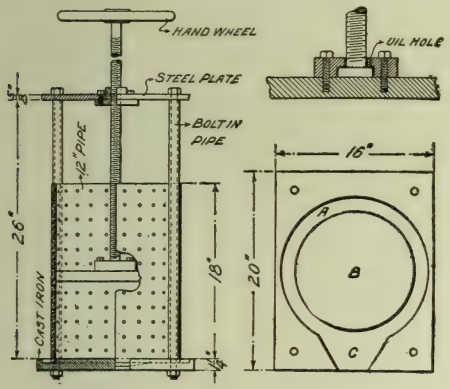
HOW TO MAKE A POLISHING WHEEL.

"For this purpose I use old felt boots," which can be obtained for little or nothing," says a correspondent in the American Blacksmith. "Each boot will make two plys. Three pairs of boots will make one wheel about 3 by 7. Put iron plates on each side about ⅛ of an inch thick, and about one inch smaller than the wheel. Bolt them together. The wheels can be made any thickness desired. To obtain a smooth surface put the wheel on emery stand shaft, use a chisel like those used for wood lathes, and hold up to the wheel on a rest. The wheel must have good speed. This makes fine polishing wheels, as they are soft and will not bump or break."

SIMPLE DESIGN FOR A WASTE PRESS.

A simple form of waste press which can be readily made from material generally at hand in a machine shop is shown in the accompanying sketches in the Street Railway Review. Only a few dimensions are given as the sizes will necessarily be varied to suit different conditions. A piece of wrought iron pipe 10x12 inches in diameter and about 18 or 20 inches in length is faced squarely at each end and drilled full of small holes of about ¼ inch in diameter spaced about 1 inch apart. A cast iron plate 1¼ inch thick is faced on top and a ring about 3 inches wide is cut as shown at A so that the pipe will fit down over the projecting part D which holds the pipe central on the plate. The front of the plate is chipped out as indicated at C, the bottom surface sloping downward towards the edge so that the oil will run off the plate.

A piece of ½-inch or ⅝-inch steel plate is used for the top of the press and this is cut about the same size as the cast iron plate at the bottom. Two plates are held apart by four 1½-inch pipes used as distances pieces, through which run bolts holding the plates firmly in place. The



Waste Press

steel plate is drilled to receive a cast iron bushing, which is threaded to receive the screw and is held in place by bolts or cap screws. The piston is made of 1-inch or 1¼-inch cast iron, and secured to this is another cast iron piece which is turned out to receive the head of the screw. The latter is upset and turned down to fit. The screw should be of 1¾-inch steel, or larger, and on its upper end it carries a hand wheel by which the press is operated.

TO MAKE COTTON FROM PINE.

Process Discovered in Bavaria That May Make Europe Independent of America

Experiments are being made in Bavaria in the manufacture of cotton out of pine wood. The method is to reduce the wood to the finest layers possible, then to subject it to a vapor pressure for ten hours. The pulp is then plunged into a soda bath where it stays 36 hours. It is thus transformed into a kind of cellulose, to which a resistant quality is given by adding oil and gelatin. Then it is drawn out and untangled by machinery.

The process is said not to be expensive and it is thought if this cottom can be made of practical use, Europe will be independent of America and India. The immense forests of Scandinavia and Germany would furnish an abundance of material.

THE FIRE PAILS WERE HANDY.

Fire buckets are made with round bottoms to hang up and thus prevent their use for other purposes. The boys got around this by making a dent in the bottom so the pail would stand alone. To circumvent this a pail was made which tapered to a point. Then the boys cut a hole in a board and laid it across a box with the pail sticking into the hole. It is a bright one who can fool the boys.

The use of flour barrels has fallen off 40 per cent during the past 12 years. People purchase by the sack.

SPECIAL SUBSCRIPTION OFFER.

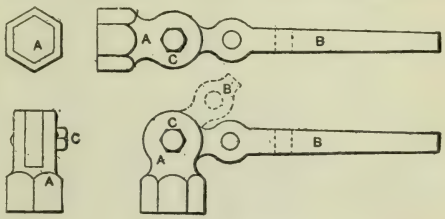
In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

POPULAR MECHANICS' PREMIUMS.

Don't forget to send for Popular Mechanics' premium list. It is sure to interest you. It will tell how you can get many desirable and serviceable articles with little effort.

A SOCKET WRENCH.

A socket wrench with adjustable stem for use in awkward places is shown in the accompanying cut. By the use of a jointed stem, as shown, the wrench is made available for nuts in almost any position and,



SOCKET WRENCH.

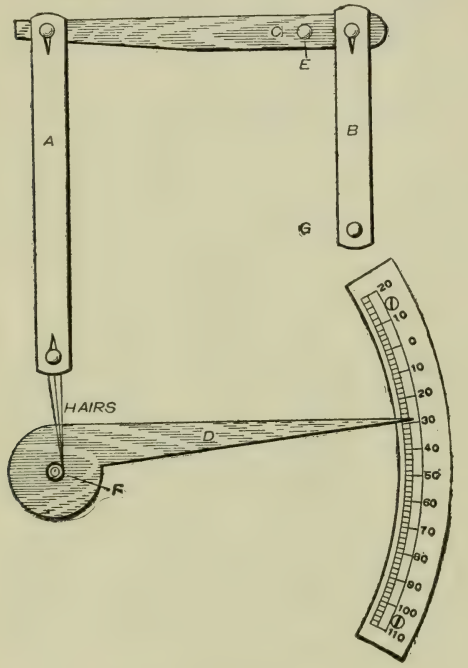
of course, will avoid marring any nut for which it is fitted by any slipping of the wrench. Sets of these wrenches may be made up with handles and sockets interchangeable, so that at slight expense they may be available for any size of nut. We are indebted to Machinery for the suggestion.

If you like Popular Mechanics please tell your friends about it.

HOW TO MAKE A CURIOUS THERMOMETER.

A thermometer which depends upon pieces of brown paper and a few horsehairs, instead of mercury or spirits, for its action, is certainly a curiosity, and cannot fail to attract attention and interest your mechanical friends. The Engineer tells how to make one.

The strips, A and B, are cut from thick brown wrapping paper, the coarser the better. Cut the strip, A, 1 inch wide and 30



A CURIOUS THERMOMETER.

inches long, and B, 1 inch wide and 20 inches long. Cut button-holes in the end of each strip as shown. The piece, C, is about 1 foot long, and is made of thin wood. The hole, E, is 4 inches from the wide end. The hand, D, is made of very thin light wood and tapers to a point at one end, a circle being formed at the other end to act as a counter weight. The principal thing to be remembered in connection with the pointer is to have the pointed end just heavy enough to overbalance the round end so that it will descend by its own weight.

A small circle of wood, F, is fastened with glue on the large end of the pointer to which the horsehairs are attached.

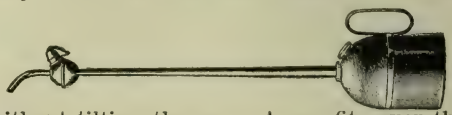
Select a place on the wall where you wish to locate the thermometer. Then first put up the lever, C, by driving a smooth wire nail, or a screw, through the hole, E. Button on strip, B, and with the lever, C, in a horizontal position put a tack or screw through the button hole, G, in the lower end of B. Now button on strip, A, to the other end of the lever, C. To the lower end of strip, A, attach three or four strands of the horsehair, bringing the strands down about 6 inches and fastening them to the under side of the small circle of wood, F, on the pointer, D. Then fasten the pointer, D, to the wall with smooth nail or screw, which is to be put through the center of the small circle, F. The lever, C, and the pointer, D, must work perfectly free and easy on the screws.

When it is cold the paper and horsehairs will contract and the pointer will rise, and when it is warm the hair and paper will expand and the pointer will descend. A scale should be made, and degree marks laid off by marking the position of the pointer corresponding to the indications of a mercury thermometer.

You will notice that this thermometer works diametrically opposite to the mercury thermometer, the pointer descending with rising temperature, and rising with falling temperature. A very slight expansion or contraction of the paper and hair will move pointer a considerable distance.

COMBINED OILER AND TORCH.

A combined oiler and torch is something which will be appreciated by many engineers. The torch receives its fuel from the body of the can and will burn 30 minutes



without tilting the can. A cap fits over the torch when the oiler is to be used in the daytime. The combination leaves one hand free, as well as lighting the part to be oiled.

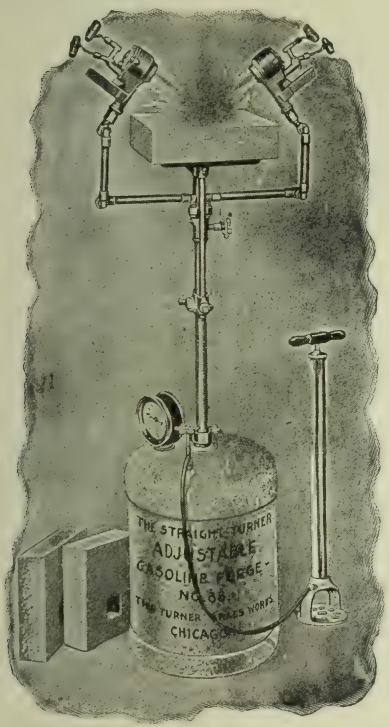
BOILING KETTLES WITHOUT COALS.

Every day in London scores of workmen's kettles are boiled in lime that will afterwards be used for its proper purpose. Just before the breakfast hour, say, one of the workmen empties a quantity of the dry lime from a sack. In the center of this lime he makes a hole, and into it water is poured. Then he puts his kettles into the water, and in a few minutes the kettles boil. In thousands of cases a fire is thus spared.

ADJUSTABLE BRAZING FORGE.

A new adjustable brazing forge is fitted with extra powerful double jet burners mounted on a compound swivel, in such a manner as to enable the operator to place the burners in any position, making this forge adjustable to all kinds of work.

The double jet burners generate a temperature of over 3,000 degrees F., which is a much higher temperature than is produced



Two-Jet Burner Brazing Forge

by any single jet burners, due to the fact that both air and gas are fed through the two jets and burned in the combustion chamber, so as to produce the maximum degree of heat from the fuel. The supply tank is made of boiler steel, strongly riveted and heavily galvanized, and each brazier is tested at a pressure of 150 pounds before shipping. This forge is specially desirable in brazing tubular axles and other work in automobile construction, and the adjustable features render it excellent for brazing large pieces of cast iron, brass, and other metals, as well as for general forge and shop work.

Any boy can own a watch if he wants to. Write to Popular Mechanics and learn how.

HINTS TO INVENTORS.

There are now 22,000 rural letter carriers in this country. Each of these routes has from 100 to 150 families. In many cases the farm house is some distance back from the road. The carrier, who rides in a covered wagon fitted up with boxes like a post-office is not required to deliver the mail to the house. A letter box must be placed at the side of the road. This compels the farmer to come out to the box when he wants his mail. Some good, simple, inexpensive system by which the letter box can be pulled along a wire by a person standing at the house is likely to meet with a large sale.

BATTERIES IN SERIES.

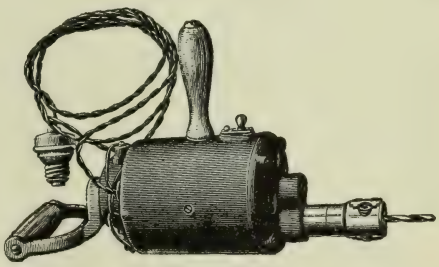
T. L. C. asks how to connect several batteries in series. Connect the zinc of one cell to the copper of the next, and so on.

WORTH A "DOLLAR A ONE."

An enthusiastic reader of this magazine in a large works in Cleveland, writes: "I would almost rather have my pay stopped than my Popular Mechanics. To me it is worth a dollar a copy."

ELECTRIC HAND DRILL.

One of the latest things in portable drills is the electric hand drill. It operates at 110 and 220 volts direct current, and can be operated in series with lamps on a railway



Electric Drill

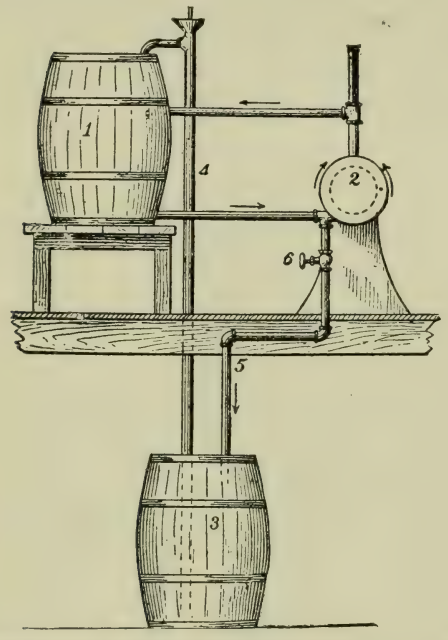
circuit, 500 volts. Current is secured by plugging the drill terminal into the socket of an ordinary incandescent lamp circuit. The drill can be used on both wood and metal work.

Send for our new premium list. We have offers that will surprise you. Everything from engines to watches.

A GASOLINE ENGINE KINK.

The problem of keeping a gasoline engine cool in cold weather and still avoiding frozen pipes or a bursted water jacket has been solved very satisfactorily by a writer in the Blacksmith and Wheelwright. The accompanying cut illustrates the arrangement used.

Two barrels and some piping are all that is required, one barrel being placed on a



bench on a level with the cylinder of the engine, and the other one below the freezing line, as shown. The figures indicate, 1—barrel for water; 2—cylinder of engine; 3—barrel for water below; 4—pump to raise water to upper barrel; 5—pipe that lets water in barrel below when done work, by turning valve 6. The pump is operated from the engine and when barrel 1 is full can be thrown out of gear.

COPPER WIRE FOR HOT BEARINGS.

An ingenious remedy for a bearing which ran hot and burned out every three weeks is described in the Woodworker. The bearing was one of three on a band saw machine. The writer says: I cut out all the old babbit metal, then got some copper wire ⅛ inch diameter and bent it in zigzag shape till I got enough bent to go the length of the bearing; laid it in the box, put the shaft in place and poured the hot babbit metal the same as though the wire was not there. The idea I had was to have the shaft bear on the copper as well as the babbit, and I succeeded.

HOW TO MAKE EVERY FURNACE PIPE HEAT.

Where there is sufficient height in the furnace room, every pipe leading to a register may be made to carry heat. The method is described by a writer in the Metal Worker, who says:

I put up a hot air furnace 42 inches in diameter and having eight pipes on it. The customer complained of two rooms not heating that were fed by pipes on opposite sides of the furnace. To overcome this trouble I resorted to an expedient that would have been impossible in a low cellar, but the furnace was in a cellar having a 12-foot ceiling. I took off the top and raised the casing 18 inches, finishing it with a flat top with a 3-inch rim around it to hold sand, and put the eight pipes in the top, running off with three-piece elbows. I put a partition in between each of the pipes, extending down to 18 inches. A plan of the under side of the top is shown herewith. This practically makes eight separate heaters over one fire, for all of the air that rises in the furnace between any pair of these partitions can only escape through the pipe from that space. The finished job gave entire satisfaction.

HOW TO MAKE A HECTOGRAPH.

A formula for making a hectograph, or composition for taking duplicate copies from one original copy written with aniline ink, is as follows: 100 parts white glue; 500 parts glycerine; 25 parts sulphate of baryta (kaolin); 375 parts of water. Soak the glue in the water until dissolved; then add the glycerine and kaolin, and cook slowly until thoroughly dissolved and smooth. Add a few drops of carbolic acid; pour the mixture into a pan and clean all scum and bubbles off the top; then set to cool. Trouble is sometimes experienced with this formula, probably because of difference in the quality of the glue or the glycerine; but, under favorable conditions, it makes a thoroughly good hectograph.

BORING AN ENGINE CYLINDER.

A 10 or 12-horsepower stationary engine cylinder may be bored on a 24-inch lathe even if you are not supplied with cast iron brackets and adjusting screws, says the Blacksmith and Wheelwright.

Get four good seasoned oak pieces, A, long enough to reach across the lathe carriage. Bore holes for the bolts, which

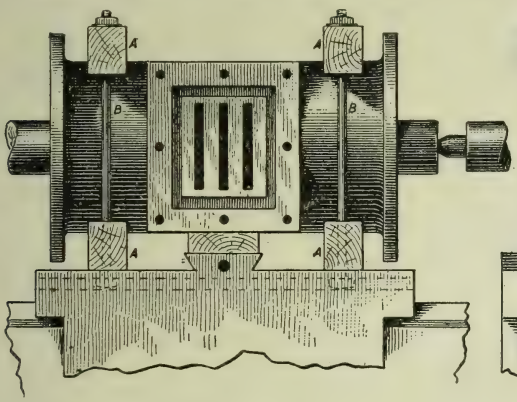


Fig. 1.

should fit T slots in carriage. Find radius outside diameter of the cylinder. Lay blocks in carriage. Take pair of dividers, set to radius of cylinders and scribe from lathe center on blocks and cut out as per dotted line in Fig. 2. Get four ⅝ or ¾-inch bolts, B, long enough to allow nuts to have a full thread after top clamp is on, as in sketch. Next place bar through cylinder and between lathe centers; put tool in bar; tighten it just enough to hold it in place; true cylinder by counter lines, on each end turning bar by hand. If too low when tightened down, loosen up and raise with pasteboard under blocks on carriage. After getting cylinder perfectly true set tool to take just enough out to true inside by taking a ruffing cut and finishing cut. Run lathe on slow speed, and feed just fine enough to make a smooth job. Never stop lathe while taking the finishing cut.

Make tool as at C, Fig. 2, of ⅝-inch round steel to suit diameter of cylinder. Give it just enough clearance to clear cylinder wall on point. Use good judgment in tightening clamps on cylinder. If too tight they will spring out of round.

What becomes of the 100,000,000 tooth picks manufactured daily in this country? Let the lodging house fellow, the loafer and the kindergartner answer.

RECIPES FOR POLISHING PASTE.

Good receipes for polishing pastes are the following:

1. 5 pounds lard or yellow vaseline melted and mixed with 1 pound fine rouge.

2. 2 pounds palm oil and 2 pounds vaseline melted together, and then 1 pound rouge, ½ pound tripoli and 1 ounce oxalic acid are stirred in.

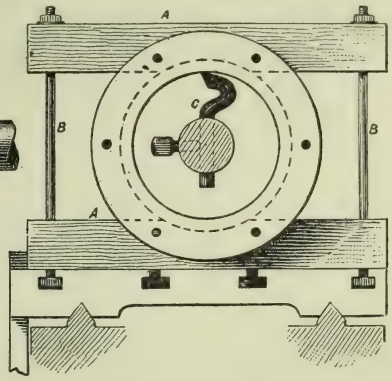


Fig. 2.

3. 4 pounds vaseline, 2 pounds oleic acid and 1 pound tripoli and sufficient kieselguhr mixed together to form a paste of suitable consistence.

4. 4 pounds vaseline and 1 pound lard, melted and mixed with 1 pound rouge.

The polishing pomades are generally perfumed with essence of mirbane and filled into tin boxes.

Polishing powders are advantageously prepared according to the following recipes:

1. 4 pounds magnesium carbonate, 4 pounds chalk and 4 pounds rouge intimately mixed.

2. 4 pounds magnesium carbonate, mixed with ¼ pound fine rouge.

3. 5 pounds fine levigated whiting and 2 pounds Venetian red ground together.

POPULATION OF CHINA.

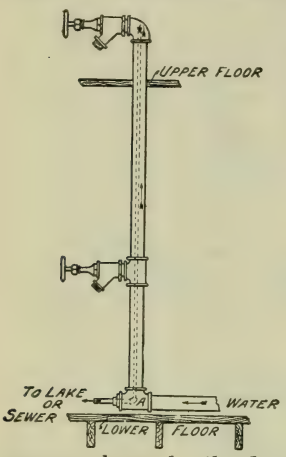
The last census taken of China places her total population at 426,447,325 inhabitants, distributed as follows: Eighteen Chinese provinces, 407,737,305; Manchuria, 8,500,000; Mongolia, 3,354,000; Tibet, 6,430,000; Chinese Turkestan, 426,000.

Will you not send us the name of at least one acquaintance whom you think might be interested in Popular Mechanics?

NON-FREEZING STAND PIPE.

Fire fighting in cold weather is always difficult, but when the water supply is allowed to freeze, what ordinarily would be only an incipient blaze often results in the complete destruction of the plant.

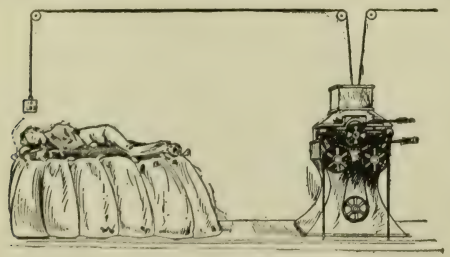
In mills that are equipped with stand pipes it sometimes happens that the building will be without heat for some time from one cause or another. At the same time it is imperative that the water supply in the stand pipes be maintained as usual, to be available in case of necessity.



An ingenious correspondent to Steam Engineering overcame the difficulty in the manner shown by the drawing. In this case the stand pipe was a 2-inch pipe with hydrants. The only change was at A, where an elbow was removed and a tee with a bushing for a ¼-inch pipe substituted. A valve was put on this ¼-inch pipe to regulate the flow. By allowing a constant small waste, it was possible to keep water in the stand pipe and still prevent it freezing.

FEED ALARM FOR SLEEPY MILLERS.

The accompanying wrinkle comes anonymously from Seneca Falls, N. Y.: It requires no explanation. The flow of the feed in the feed hopper, by gravity, causes a dingus, provided with an eccentric, to revolve. When the feed ceases, the dingus



stops revolving, the eccentric slips and a ten-pound weight drops on the head of the sleeping miller. This will cause the miller to awake. If it does not, the weight should be increased. The dingus can be made of any metallic substance. The miller should be of combustible material so that he can be fired.

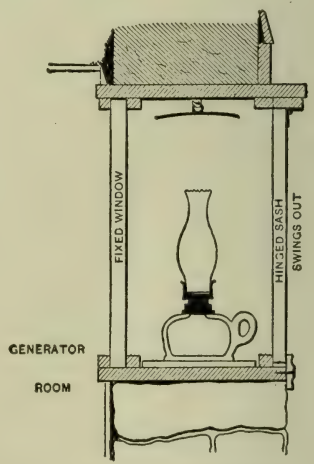
IMPROVEMENT IN BOBSLEDS.

An improvement in bob-sleds has recently been patented by a Minnesota man. Each runner is hung loose on an axle which per-

mits any one of the four runners to pass over obstructions with less strain and jar to the pair of runners.

DEVICE TO PREVENT EXPLOSIONS OF ACETYLENE.

Under no circumstances should an artificial light be taken into the room where the acetylene generators are placed. Many of the terrible explosions which have blown



stores and houses into fragments, like a charge of dynamite, have been caused by the careless striking of a match or the taking of a lighted lamp into the generating room. An article in the Acetylene Journal urges great precautions in this respect and tells how to light the room. Small windows should be placed to allow daylight to enter, and at night a lamp placed in a box outside the room can be used with safety.

Popular Mechanics "is written so you can understand it."

Lathe Attachments

Copyrighted 1904 by W. W. Wood.

Part I. General Introduction and Description of Division Plate and Pointer.
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle.
Part V. Gear Wheels and Rotary Cutters.
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

MILLING ATTACHMENT FOR ROTARY CUTTERS.

Having occasion to make some small gears I designed and built the milling attachment as shown in Figs. 1, 2 and 3, and which is secured to the slide rest of lathe by means of a small bar of iron which goes through the slot in tool post and over the two lugs, a and a^1, Fig. 3, and is clamped down by the screw in tool post.

Fig. 1 is a side elevation showing spindle with driving pulley and a gear cutter in place and portion of belt from overhead.

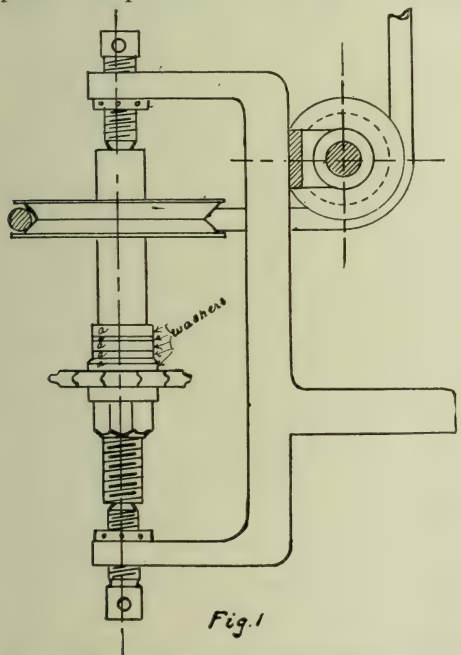


Fig. 1

The left hand pulley is left off for the sake of clearness.

Fig. 2 shows a rear elevation and Fig. 3 is a plan or view of the attachment from directly over it.

A wooden pattern is made for the frame which is to be of cast iron. Also a pattern for pulleys and their supports which are cast in brass.

When the castings are procured, proceed to dress the casting for frame, taking pains to get the holding-down lugs perfectly square and at right angles with the frame. Then drill and tap the holes for the bearing screws between which the spindle revolves, being very careful to get them straight with each other and the frame. Next file up the casting for the pulley supports, drill and tap the holes for screwing in the spindles and fasten onto frame by means of two short screws as shown in Fig. 2. Now turn up the spindles from a piece of steel as shown at Fig. 3, screwing one end externally to fit the tapped holes in the supports and drilling and tapping the other end internally to receive the flat headed screw, at Fig. 3, which holds the pulley in place. Another way to secure the pulley on the spindle is to extend the spindle and thread it externally as at opposite end, leaving a slight shoulder and using a nut and washer. Now, make the spindle, as shown in Fig. 1, leaving a shoulder which the washers, shown at Fig. 1, will fit up against and thread the other end to take nut and washer, which, when screwed up tight, holds the milling cutter in place. The several turned wash-

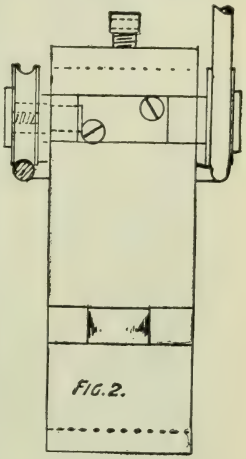
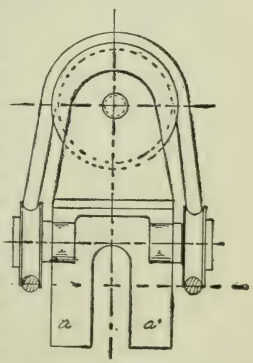
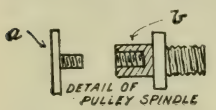


Fig. 2.



Plan. Fig 3.

ers are used for adjustment and further adjustment can be made by the bearing screws at each end. The driving pulley on spindle is secured either by a grub screw or keyed to the spindle. To make the bearing centers in spindle first, drill a hole about ½ in. deep using a small drill, and then open out with a countersink of same angle as the tapered end of bearing screws. Both the ends of the screws and the spindle should be case hardened. This can be accomplished by heating them to bright red and rolling them in some powdered cyanide of potash, cooling out in water. Be careful not to inhale the fumes or get cyanide on the hands, as it is deadly poison. Tommy holes should be drilled through the heads of bearing screws and also in the edge of threaded washers which are used as lock nuts to keep screws from coming out or turning when the spindle is in motion.



The cutter is made from a piece of steel and is turned up so that the edge is of the exact section of the cut to be made as, for instance, a gear tooth, and then divided into ten or more parts and teeth filed, making it into a kind of circular saw. To cut a gear, the blank is held on a mandrel between lathe centers. The milling frame is mounted on the slide rest and cutter adjusted so the center line of cutter is on a line with centers of lathe. The division plate is used to space the gear blank. When everything is in place start the lathe, using the belt from the over-head to drive the cutter. Advance the cutter to work by means of the cross slide and make the cut by means of the other slide. When one cut is finished turn the blank for the next cut, counting off the number of holes in the division plate. Make the cut and proceed as before until teeth are all cut. More detailed information regarding cutters and gears will be given in a future article. The next will be on a milling and drilling spindle for ornamental work, etc.

THAWING SERVICE WATER PIPES BY ELECTRICITY.

No more digging up the frozen pavement to thaw out water pipes. An electric current taken from the street railway trolley line or lighting socket in the house or store will do the work, surely, safely and in 15 minutes. The past winter has been unusually severe on the service pipes leading from the street into buildings and scores of consumers all over the country have been out of water for days at a time.

The electric method was discovered several years ago by an electrician in Madison, Wis., and the wonder is the plan has not been universally adopted. Nearly all towns which have water works have also an electric light system. The thawing is done as follows: One electrician and two unskilled assistants. Connection is first made by means of an insulated wire to the source of current, which is passed through a transformer. The transformer reduces the intensity of the railway current, and increases that of the incandescent service. From the transformer a wire connects to some faucet in the house.

Another wire is run, connecting the nearest fire plug to the return circuit of the trolley line or lighting system. This establishes a current through the frozen pipe which is heated and melts the ice contained in the pipe. A considerable amount of current is required, but the expense by this method is usually about half what it costs to open a trench and thaw with steam boilers, while the time consumed is very small, the pavement is undisturbed and no litter made.

Those of our readers interested in plumbing business or work, who have not already equipped their shops for electric thawing, will find it profitable to do so in good season for next winter.

HOW TO RENDER CLOTHES FIREPROOF.

The light, fluffy garments of children, as well as the heavier textures worn by adults, can be rendered fireproof, or at least to an extent in which they will not readily ignite. The method is simple and inexpensive, and the chemical used can be purchased for a few cents at any drug store.

Dr. Doremus, a celebrated chemist, tells how to do it: "After the heart-rending loss of a young son, whose summer dress took fire from a candle flame, I made a thorough search among chemical agents to determine which would most effectively render dresses non-inflammable. None equaled ammonium phosphate. Each time the underclothing and dresses of my children were washed this chemical was added to the starch solution, which rendered them flame proof. For forty years I have urged the employment of chemical agents to save life, but the apathy of the public surpasses belief."

GOVERNMENT PRINTING OFFICE WAKES UP.

Adoption of Typesetting Machines at Last Being Considered—Means Enormous Saving

At last the government printing office at Washington is considering the adoption of typesetting machines with which the work of that mammoth institution may be done nearly 40 per cent cheaper than it is now done by hand composition. Although these machines have long since been established in the smallest newspaper offices in the United States and have long been regarded as a necessity by them, the United States government has been content to mope along with an antiquated method of typesetting that the most insignificant country daily would have held to ridicule. The excuse of the government for its Chinese-like lethargy is that labor unions would oppose the installation of such an improvement that would save the government thousands of dollars but throw a number of men out of work.

Labor leaders of the size of Mitchell and Gompers have all many times declared that reputable labor bodies of America do not oppose the introduction of labor-saving devices and that such opposition is inexpedient and unwise.

This disposition of the government to adhere to antiquated methods is not characteristic of the past. The printing office did not retain the old flat-bed hand press after the cylinder press was invented; it did not insist in carrying mail by the old stage coach when the railroad and mail cars came into use; it did not oppose the introduction of electric stamping machines used in cancellation—yet all of these, as are all acceptable inventions, were great labor savers. As a matter of fact the introduction of the railway mail car has so vastly improved and cheapened the service that it has enabled the handling of thousands of tons more mail at greatly reduced postage and thus given employment to thousands more men than would be required under the old mail stage coach.

TO POLISH BRASS.

Smooth brass with a fine file; rub with a smooth fine grain stone, or with charcoal and water. When quite smooth, polish with rotten stone and oil, spirits of turpentine, or alcohol.

REMARKABLE FIRE PHOTOGRAPH.

Picture of Baltimore Conflagration Taken by the Light of the Flames

A remarkable photograph of the Baltimore fire, taken by the light of the fire, while the conflagration raged, has been received by Popular Mechanics. The picture was taken at a time when the fire was making its way into the heart of the city and

Photograph of Burning Baltimore Taken by the Light of the Fire

feeding on the skyscrapers, just before building after building was blown up with dynamite in a vain effort to cut off the flames. The scene is different from that in the Chicago fire of 1871, when the people instead of standing about were running for their lives to avoid being overtaken by the flames which were sweeping over the city with such phenomenal speed. The photo is by Purcell.

Do you need a watch? An hour's work will earn you one. Write to Popular Mechanics and learn how.

Popular Mechanics
A MONTHLY MAGAZINE
"Written so You Can Understand It"
PUBLISHED BY POPULAR MECHANICS CO.
Journal Building Chicago, Illinois

SUBSCRIPTION
United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00
Foreign Countries, post paid, - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS
JOURNAL BUILDING, : : : CHICAGO

LONG DISTANCE TELEPHONE MAIN 2682

Entered at Chicago Postoffice as mail matter of the Second Class

HISTORY'S GREATEST RAILWAY PROJECT

In the Grand Trunk Extension England's Dream of 500 Years is Being Realized

In the construction of the Canadian Trans-Continental railway Britain's dream of 500 years is being realized. Success of the project is now assured, due to the efforts of Sir Charles Rivers Wilson and C. M. Hays. Plans for the construction of the Grand Trunk Pacific railway to extend from North Bay or Gravenhurst, Ont., to either Butte Inlet or Port Simpson, a distance of 3,025 miles, have been approved by the stockholders and directors of the Grand Trunk railway. The Canadian government has agreed to construct a portion of the road and guarantee the bonds to be issued for the remaining portion.

This undertaking outranks any single railway project in history with the possible exception of the Trans-Siberian railway. But this road will be of equipment far superior to the Trans-Siberian road. The total cost will reach the enormous figure of $125,000,000. The road will afford the shortest route to the Orient from Liverpool, from the large centers of Canada, from New York and the manufacturing centers of the East and an equal route to the Orient from Chicago and the Middle West. It will be the lowest grade mountain line on the continent and will give 7,200 miles of continuous railway with steamship connections, over which rates can be made to every part of the world without consultation with friendly or unfriendly connections.

The Eastern states will be reached by the Central Vermont of the Grand Trunk system; the gateways of Chicago, Detroit and Port Huron by the Grand Trunk Western, both roads to make short connections with the Trans-Continental railway.

From New York to Yokohama, by way of Montreal, the distance over the new line will be 418 miles shorter than by the Canadian Pacific, 555 miles shorter than by Chicago and San Francisco and 1,800 miles shorter than by Galveston and San Francisco. From Liverpool to Yokohama by way of Quebec the distance will be 528 miles shorter than by the Canadian Pacific, 1,313 miles shorter than by New York and San Francisco and 130 miles shorter than by Moscow and the Trans-Siberian railway. From Chicago and Milwaukee to Yokohama by the Grand Trunk will be 535 miles longer than by the short route via St. Paul and the Canadian Pacific, but shorter in time, and will be 265 miles shorter than by St. Paul and Winnipeg.

This road will add millions to the wealth of Canada in increasing its Oriental trade. Canadian exports to the Orient increased from $93,827,077 in 1890 to $211,640,286 in 1902. In the United States the increase was from $151,100,000 to $433,850,000. Along the lines of the Grand Trunk there are located 45 cities and towns of more than 4,000 inhabitants each and aggregating 1,000,940, which is 18.7 per cent of Canada's population. From these towns the bulk of manufactured articles are now shipped to the Northwest and exported.

The line will penetrate the vast area of unoccupied fertile land of northwestern Canada. These lands amount to 500,000,000 acres, which are equal to five-eighths of the total farm area of the United States. Of the 15,400,000 acres of occupied land there, only 6,000,000 acres are under cultivation. These 6,000,000 acres in 1902 produced 60,000,000 bushels of wheat. The unoccupied lands are said to be capable of producing three billion bushels of wheat annually, or a production five times greater than the total United States crop of 1900.

MACHINE TO SPLIT WOOD.

A Spokane man has invented a machine capable of splitting wood 2 feet long and 18 inches thick. The machine is run by a three horse power gasoline engine and consists of a huge knife working through the knottiest wood at the rate of 60 strokes per minute. A contrivance to carry off the wood is to be added to the machine.

IROQUOIS CURTAIN EXONERATED.

New Facts Tend to Show Its Condemnation Was Unjust und That It Was Really Fireproof

After the excitement and indignation, resulting from the Iroquois fire, has subsided, a clear and cool observation of the causes that led to the wholesale destruction of life, tends to exonerate the now famous asbestos curtain from the charges that were brought against it. The curtain, it is now believed, withstood the flames remarkably well and its partial destruction was caused by the deluge of water thrown against it when hot, and the axes of the firemen, and by being frozen over and trampled under foot after it had fallen. It is proved beyond doubt that the curtain caught on some obstruction when an attempt was made to let it down and that it was never lowered.

Mr. George W. Stetson, Secretary of the C. W. Trainer Manufacturing Company, which made the Iroquois curtain, explained before the Grand Jury that it was necessary in order to weave asbestos to mix with it a small amount of cotton, say, three or five per cent, not three parts cotton as has been charged.

He also testified, "We manufacture one grade, but two kinds. One kind consists of what is known as pure asbestos cloth. The other kind consists of the same cloth with a wire insertion. The only difference in the nature of the curtains is that the one with the wire insertion has greater textile strength."

Mr. Stetson on his return to Boston, the home of the manufacturer, made this statement:

"The writer has just returned from Chicago after making a careful examination of the stage of the Iroquois theatre and to dispel any doubts that may be entertained as to the fireproof qualities of the asbestos curtain used there, or rather the asbestos curtain which the testimony before Coroner Traeger seems to show conclusively was not used, begs to submit the following facts:

"First—Large portions of the asbestos curtain were found lying across the stage extending from one side of the proscenium arch to the other. The curtain apparently hung suspended above the arch and remained there until the fire burned away its supports, when it dropped to the stage, falling almost underneath the point from which it was hung. It must have been heated to a very high temperature by the intense fire surrounding it, and as soon as it fell was deluged by water from the firemen's hose. This is shown conclusively from the fact that in order to recover portions of it, they had to be chopped out with a hatchet, as the whole mass was frozen solid. Even after such usage as this, which no mineral would stand without disintegration, the pieces of curtain imbedded part way through the mass and which were protected while hot, to some extent, from the water, were found to have retained their tensile strength and pliability. This is an excellent proof of the quality and strength of the asbestos curtain We have in our possession a piece of the asbestos curtain brought back by the writer which may be seen at our office in substantiation of our claims.

"Second—The inquest has shown that when the fire started in the drops, the asbestos curtain was called for, but apparently a mistake was made and the "act drop" was lowered instead. This, of course, burned and the public, through statements credited to prominent persons, was led to believe that the asbestos curtain burned. Superficial examination shows that pieces of "burlap backed" screens had been picked up and as they were painted with a mineral composition, hasty conclusions were drawn that these were pieces of the asbestos curtain. Meanwhile the asbestos curtain was covered with debris and was being trampled under foot by the curious.

"Third—There is little doubt that had the asbestos curtain been lowered, it would have acted as a damper, preventing the great draught of air from the auditorium from forcing the flames up through and among the drops, and would have thus temporarily held back and partially checked their spread. The audience, no doubt, had faith in the asbestos curtain, for testimony shows that they kept their seats until they saw a burning curtain lowered; and the awful panic followed. There is no doubt that the sight of what they supposed was the asbestos curtain in flames, brought terror with it. Can we not draw the following conclusions:

"Firstly, that the asbestos curtain was of a high grade asbestos material and thoroughly substantial?

"Secondly, that the asbestos curtain was not lowered?

"Thirdly, that had it been lowered, immediately, the progress of the fire would have been temporarily checked?

"Fourthly, that had it been lowered, the audience would have felt secure, a panic would have been averted and the patrons would have left the theatre without confusion?

"Fifthly, that it is safe to say 571 lives would not have been lost?"

Doubtless we can safely say so and the better the facts are known the greater will be the proof that a real asbestos curtain will not burn.

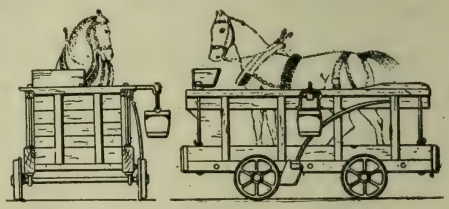
The erroneous reports made regarding the Iroquois curtain are probably responsible for the fact that no asbestos curtains are to be used in any of the Chicago theatres. The new ordinance drafted and passed after the Iroquois fire, requires the use of steel curtains instead of asbestos. This, however, is all the result of hasty and publicly enforced legislation, and the groundless prejudice in Chicago against asbestos will doubtless wear away when it becomes universally known that the Iroquois curtain was never burned and has been unjustly condemned.

PHOTOGRAPHING FISH FROM LIFE.

Photographs showing fish swimming about in their natural element are a new acquisition to science made possible by recent inventions in photography. The photograph from which the accompanying picture is obtained was made direct from life while the fish was swimming in a tank. The fish passed directly across the plate giving the severest test for speed. The curtain slide shutter, which will make a picture with 1-1000 part of a second's exposure was used in the snapshot. The negative was made with an anastigmat lens.

WHEN HORSES RODE.

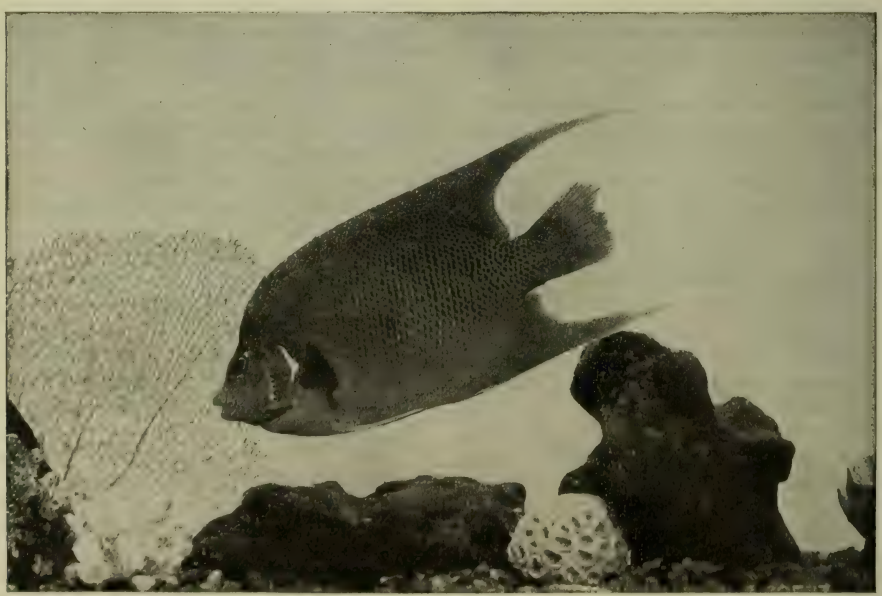
There was a period in the development of transportation facilities when horses rode. A train of cars was followed by a



Dandy Cart

low truck, termed a "Dandy Cart," in which the horse rode down the inclines, gravity being the motive force. The cars ran over roads built for that purpose and were used for hauling coal from mines, the horse going along to draw back the empty cars.

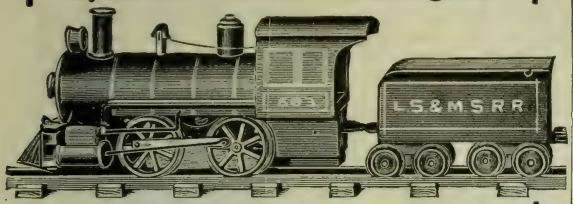
The Railroad Gazette says the Dandy Cart came into use about 1827.



Fish Photographed While Swimming

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



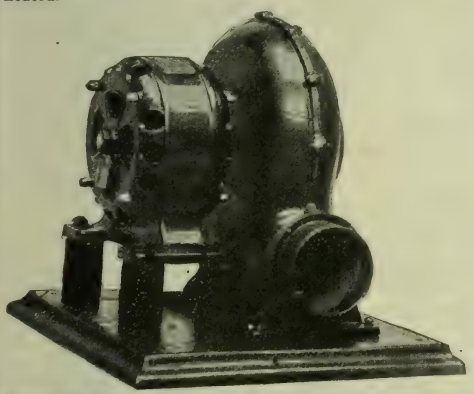
Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio

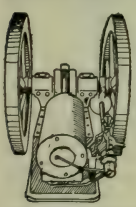
NEW ERA ELECTRIC BLOWER

Direct connected, has been designed especially for the blacksmith, and it is his ever ready helper that works for less than five cents a day, and never tires. It places him on an equal footing with the largest steam shops and allows him to work steadily at the anvil while his work is being "electrically" heated.



WRITE FOR CIRCULAR AND PARTICULARS

NEW ERA ELECTRIC CO., 942 W. Lake St., Chicago



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

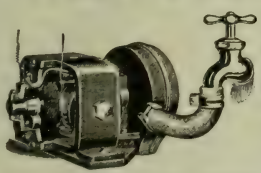
CAVANAUGH & DARLEY

25 West Randolph Street, Chicago

WE MANUFACTURE THE BEST

designed, finest constructed, most efficient type of miniature

Water Power Plants



For generating electricity at practically no expense. 3 sizes nominal capacity 25-50-75 watts. To the electrical student these outfits will furnish the most efficient instruction. Postal brings catalogue of dynamos, motors, steam and gasoline engines, novelties, water motors, etc. Write now. Don't delay. Good live agents wanted in every town.

C. S. PIPER & CO., Detroit, Mich.

THE HERO OF THE TRAIN.

Written for Popular Mechanics by George R. Harrison.

Called from the peace of his slumber,
Called from the deep of a dream,
Called from the hour of his comfort,
Where fondness is reigning supreme.
A lingered caress for a darling,
A kiss for a drowsy one's lips,
A hurried good-bye at the doorway,
And into the darkness he slips.

Into the glare of the roundhouse,
Greeting his comrades of men,
Climbing the steps to the engine,
And gripping the throttle again;
Creeping away to the country,
By slumber-still meadows and vales,
Watching the gleam of the headlight,
That travels the musical rails.

Gloom looking out of the heavens,
Gloom to the left and the right;
Gloom trailing after the rattle,
And gloom just ahead of the light.
Danger is haunting the bridges,
And danger is lurking the curves,
But bravely he keeps his position—
So nobly his duty he serves.

Proud as a conquering warrior,
When laurels of battles are won,
He rides, looking constantly forward,
Till reaching the end of the run.
A bite and a drink at a counter,
A craving for sleep all in vain,
Followed again by a "call-boy,"
With an order of "Back to the train."

Back again over the country,
By woodlands all kissed with the light;
The blossoms all beck in the breezes
To signal him on in his flight.
The green of the grass is a dazzle,
The telegraph poles glimmer by;
He sings to his mate "Feed 'er faster!"—
She belches her smoke to the sky.

Home again, man of the railroad!
Back with the ones that impart
A welcome of love and laughter,
And music that lightens the heart.
Bask in the joy while you linger,
For duty, perhaps, is your doom;
Fate may be waiting to grasp you
And roll you away to the tomb.

The world rushes on with its rabble—
The nations trump not of his fame;
Tho' his breast is not blazoned with badges,
We know he's a hero the same!
Let others sing songs of the soldier,
Or the lad of the billowy main,
But while they are singing we'll echo
A song for the main of the train.

RODE A KITE 1600 FEET IN AIR.

With a telephone apparatus hanging from his shoulders, and paying out its long coil as he went, S. F. Cody, who conducted some kite-flying experiments at Alexandria Park, ascended by kite 1600 feet and from this height conversed with inhabitants of this nether world.

In the ascent the entire 2000 feet of cable was used, the man-carriers being 1600 feet above the earth and the pilot kite 1000 feet higher yet. In previous ascents 1200 feet is the greatest height attained.

Korea's concession to Russia that she might cut timber in the Yalu valley is said to have started the trouble between Russia and Japan.

MODELS & GEARS
CATALOGUES FREE
UNION MODEL WORKS
193 CLARK CHICAGO.

F. D. CROFOOT N. NIELSON
BLUE PRINTING BY ELECTRIC LIGHT
BLUE PRINTERS BLUE PRINTING, BLACK PRINTING, BLUE LINE & COLOR PRINTING
WRITE FOR PRICES.
CROFOOT, NEILSEN & CO.
167-169 E. Washington St. - - CHICAGO

MODELS
CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES
ESTABLISHED 1867

MODELS AND SUPPLIES
WE MAKE
Working Models of Your Invention
After drawing or description, and charge moderate and fixed price for them. Experience, skill and modern equipped shop enables us to satisfy and assist you.
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Ave., Chicago

DIES, TOOLS, MODELS AND SPECIAL MACHINERY
Metal Specialties and Stampings Manufactured
HOEFT & MOORE, Chicago, U. S. A.
OFFICE: 85-87 Fifth Ave. WORKS: Indiana and Franklin Sts.

FOOT and POWER
AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::
SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

SPECIAL MANUFACTURING
Special MACHINERY-MODELS-EXPERIMENTAL WORK. DIES and STAMPING, Prompt. "Write for our booklet." The GLOBE MACH. & STAMPING CO.
970 Hamilton Street - - - Cleveland, Ohio

HOW TO KNOW WHEN A PERSON IS DEAD.

Of all the things most to be dreaded is that of being buried alive. There can be no possibility of such a thing if the following directions given by Dr. J. D. Johnson, an eminent physician of Philadelphia, are followed. His directions are so simple they will be readily understood.

In all cases of apparent death occurring suddenly, or from external violence, and whenever there is any doubt in the matter, extraordinary precautions should be taken in order to settle the question. The cessation of respiration and circulation (so far as can be observed) does not determine the matter, and even the absence of animal heat is not conclusive, for life may exist and recovery take place where this is not an attendant. In all doubtful cases the following tests should be applied:

Put the body in a dark room, place the hand (with fingers close together) between the eye and a lighted candle; if life is not extinct, hand will show transparent redness as in life.

Tie a cord tightly around a finger; if the end becomes swollen and red life is not extinct.

Inject a few drops of aqua ammonia under the skin; if life still exists a red or purple spot will form.

Insert a bright steel needle into the flesh; allow it to remain half an hour; if life is extinct it will tarnish by oxidation.

Place the surface of a cold mirror over the mouth; if moisture condenses on the surface respiration has not ceased.

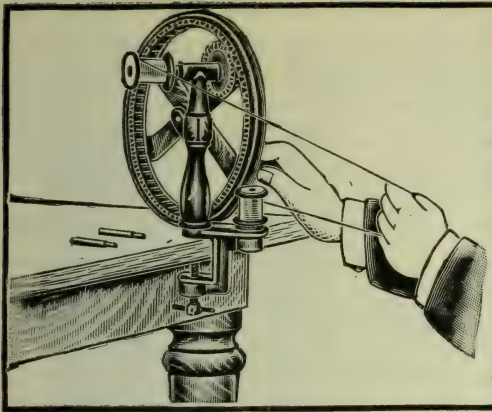
In from 12 to 18 hours after death eye-balls become soft, inelastic, feel flaccid.

In from 8 to 12 hours after death hypostasis or congestion of blood in capillaries begins to form in all depending parts of the body.

Putrefaction is positive proof of death, and unless this takes place by the end of the third day, interment should be postponed until it does.

While it is a fact that there is no machine or device in use improvements of which could not be profitable, there are many kinds of appliances that specially need to be improved and the successful inventors of such improvements will reap quick and ample returns. In wooden ware there is a demand for improved step-ladders, ironing boards, curtain stretchers, kitchen cabinets, benches. In metal ware for use in the household, there is ample room for improvements in cooking utensils, including pans, strainers, graters, lids, lifters, etc. In building material there has been great advances in the last two years in the making of bricks, building blocks, shingles and other forms required in the construction of buildings, out of cement, terra cotta and other fireproof compositions, and also in the construction of metal windows, window frames, doors, stairways. Sheet metal is being substituted for wood in the manufacture of furniture and all kinds of office appliances, and the field for improvements in these lines, whereby the article is made more ornamental or stronger or more durable, is almost limitless.

The use of sheet metal in the construction of railroad cars is being greatly extended and some of the wealthiest men, such as Cornelius Vanderbilt, and large corporations, are devoting money and brains to the perfection of metallic construction in railway appliances of all kinds. The production of metal is now so extensive and cheap that it is found to be more economical than wood, and its durability is very much greater. The extension of mail facilities to the countryside has opened a great field for new devices in transmitting and delivering mail, and at the present rate of progress it will be but a short time when the farmer will have his mail delivered as promptly and as conveniently as the resident of a town or city.



Harvard Magnet Winder

Designed for use in telephone and telegraph offices for unwinding and rewinding Electro Magnets.

The cut shows a Magnet being wound from a spool of wire which is supported on a Stud in the clamp.

A hub like that shown lying on the table is used to support the Magnet, one end of the hub screwing on the spindle of the machine, the other end screwing in the thread in the Magnet Core. The spool and magnet hubs are interchangeable.

To unwind a Magnet it is placed in the stud shown occupied by the spool, and the latter is screwed on the spindle. The operation of winding is clearly shown by the illustration.

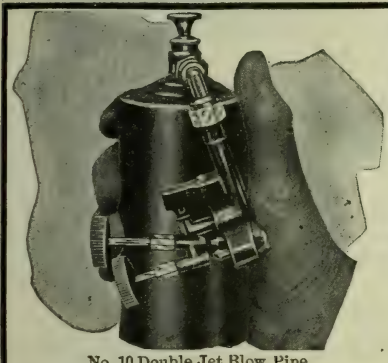
It is finished in enamel and striped.

With each winder we furnish a wooden spool, also one 6-32 hub and one 8-32 hub.

PRICE COMPLETE, $3.00 EACH

Harvard Electric Co.

224-226 South Clinton Street, Chicago



No. 10 Double Jet Blow Pipe
Capacity 3-4 pint. Weight 2 pounds

NEEDLE FLAME

OVER 3,000

THE TURNER DOUBLE JET ALCOHOL BLOW PIPE NO. 10

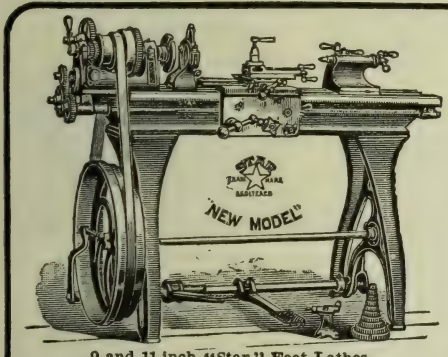
Has the nearest approach to the Oxy Hydrogen Blow Pipe Jet invented and is made so compact it can be carried in the pocket. The fuel is wood alcohol and it will run 3 hours at full blast from one filling. The flame is non-oxidizing and can be regulated from a needle point to a brush flame. Unexcelled for jeweler's and optician's work, fine brazing and soldering.

LABORATORY AND EXPERIMENTAL WORK AND LEAD BURNING

SEND FOR CIRCULAR

The Turner Brass Works

55 North Franklin Street, Chicago



9 and 11-inch "Star" Foot Lathes.
9, 11, 12 and 14-inch "Star" Power Lathes

STAR LATHES

Foot and Power...

High-grade screw-cutting engine Lathes, with forged crucible steel hollow spindles, phosphor bronze bearings, gear-driven reversible feeds with strong friction drive in apron, our patented spring nuts which allow quick shifts of change gears, also Draw-in Chuck, Gear-cutting, Milling and Taper Attachments if desired.

Suitable for electrical and repair work, model makers, gunsmiths, technical schools and fine, accurate machine-shop and tool-room service. Ask for COMPLETE DESCRIPTIONS.

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N. Y., U. S. A.

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

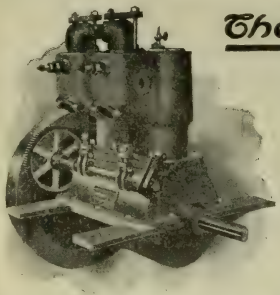
WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.



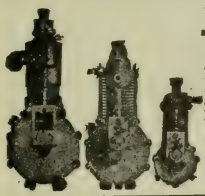
The Hoffman Motors

ANY HORSE POWER for AUTOMOBILE or MARINE

Write for CATALOG and PRICES

H. L. HOFFMAN MOTOR CO.

28 West Randolph Street, Chicago



1 3-4 H. P. Bike Motor $7.50

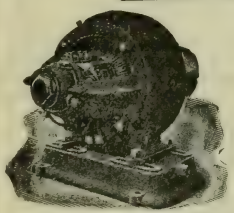
Castings with Drawings 1904 Model

Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. Send for circular to

EUREKA MFG. & SUPPLY CO.

ST. PAUL, MINN.

Everything in Dynamos and Motors



$\frac{1}{20th}$ UP

Write us for Particulars and Prices

NORTHWESTERN ELECTRIC COMPANY

69 West Washington Street, Chicago, U. S. A

Peerless Electric Co.

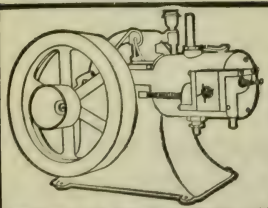
ELECTRICAL REPAIRING

RECORDING WATTMETERS

SEND FOR BARGAIN SHEET

141-143 South Clinton Street

'Phone Main 1025 Chicago



1-4 H. P. Gas Engine

Castings for $15 up

with blue prints. Cylinder bored out and faced off.

Runs by gas or gasoline. Water Jacketed. 1-2 H. P. castings, not bored or faced, $16.00. Send for catalog of engines, dynamos, electrical supplies.

L. W. GILLESPIE & CO., 238 E. 4th Street, MARION, IND.

KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog

Int'l Power Vehicle Co., 56 W. Wash. St., Chicago, Ill.

COSTLY SNAKE RODS.

Natives of India who wear sandals or go barefoot, resort to a peculiar practice of carrying, for protection against snakes, an iron rod having a knob at one end, a hook at the other end and threaded with a few loose rings. The jingle of the rings against the rod as the native passes along frightens the reptiles out of his path.

H. Hervey, former Government Telegraph Inspector of India, tells of the pilfering of telegraph wire to use for snake rods. The wily Indian chooses a piece of wire strung so low that he can blame the cattle with its destruction. With two pieces of flint he pounds a cross guy loose and then pounds off his length of wire. If the village blacksmith, to whom he takes the bright wand, wonders, he does not betray. Rather he protects his customer from embarrassing inquiries by removing every trace of the bright coating—much to the customer's chagrin.

P. M. SELLS AT SIGHT.

Mr. Will Runcie, book and newsdealer at Albion, Ill., writes the Popular Mechanics a voluntary testimonial as follows:

"I am selling your Popular Mechanics, and all one has to do is to show it to anyone at all interested in mechanics. or who wishes to be posted along this line of study, and you can sell it.

"I have paid but very little attention to your magazine (for in fact most all publications along this line are too deep for the average reader to become at all interested in), and very much to my surprise, I found on looking over the February and March issues of your magazine that they were very entertaining reading, aside from the useful information they contain."

HOW CASTOR OIL IS MADE.

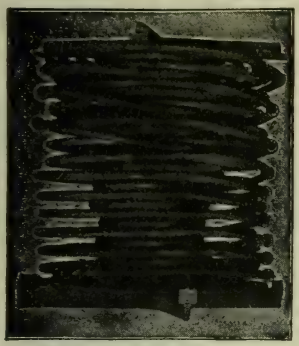
Castor oil is made principally in California, Italy, Mexico and India, but most extensively in California. There are two distinct processes of extracting the oil from the seed, i. e., expression and decoction. While the latter process is adopted in Italy and India, the California manufacturers, and most of the Mexican manufacturers, obtain the oil in the following manner:

After gathering the seed in the fall of the year, they are placed in drying furnaces for an hour or so, for a sufficient time to soften the seeds, as the greater percentage of the oil contained in a seed can be obtained when the seed is soft. After they have been removed from the dryer, they are placed in the press, similar to a cider press, and the seeds are crushed. The oil runs into a large bowl directly beneath this press and is mixed with about an equal portion of water and boiled for one and one-half or two hours—thus precipitating the albumen and other impurities. When cool, there will be a thin scum on top, which is skimmed off. The water and oil are then separated, sometimes by running the water off and sometimes by 'baling' out the oil, which is placed in the 'sun tanks' (tanks of metal exposed to the sun), where it bleaches for eight or ten hours, and is then removed to the storeroom, where it is placed in barrels, carboys, etc., ready for the market. Some of the trees in California reach a height of fifty feet, and the seeds from one tree contain as much as fifteen gallons of pure oil.

In more northern latitudes the castor oil plant rarely grows higher than three feet, and is used for ornamental purposes, while in warmer countries it becomes a tree.

Our New **FLASH BOILER**

For 1904



Write for Full Particulars.

No burning of boiler—No water glass—No smoke. Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

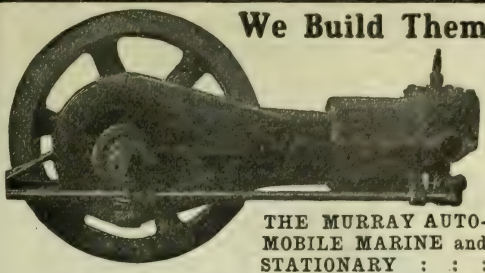
Condensers, and other appliances are marvels of mechanical development.

See our exhibit at Chicago Automobile Show.

Barton Boiler Company

SOLE MANUFACTURERS,

4230 State St., Chicago, Ill., U. S. A.



We Build Them

THE MURRAY AUTOMOBILE MARINE and STATIONARY : : :

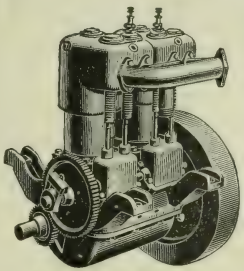
GASOLINE ENGINES

Transmission, Gears, Carburetters, Pumps, Mufflers, Etc.

Write for Circular and Prices before ordering.

W. B. MURRAY, 1253 Milwaukee Ave., Chicago

DOUBLE CYLINDER



Gasoline MOTORS

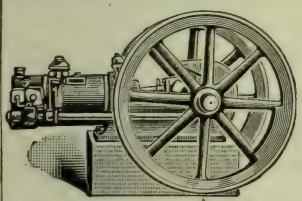
4½ BORE. 5½ STROKE

12 H. P.

Simple—Reliable.

Write us for full particulars and prices

JACKSON MOTOR CO. 43 N. Union St., Chicago



"OTTO" means Economy in Gas and Gasoline Engines.

Fuel economy is due to correct design.

Economy in the use of fuel.

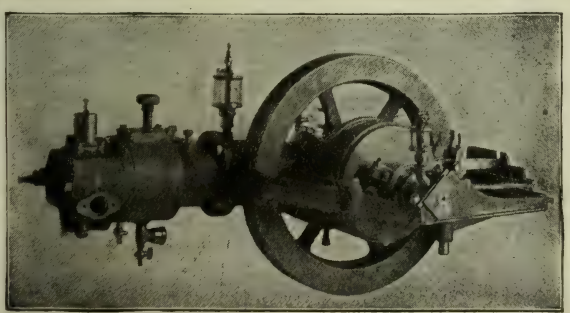
Economy in the cost of maintenance.

Economy in first cost because of great durability.

Slight cost of maintenance and great length of life are due to good materials and fine workmanship; cold facts that 75,000 users stand ready to vouch for and the logical results of 28 years of experience.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street **MINNEAPOLIS: 318 3rd Street** **OMAHA: 1108 Farnum St.**



ENGINES - -

Vertical and Horizontal

4 to 20 Horse-Power for

AUTOMOBILES

with and without Transmission

Send 4c. Stamp for Catalogue.

The Automobile Supply Co.

Successors to

THE P. J. DASEY CO.

Marine Building, Chicago

Crescent Portable

Lamp Guard

Useful
Ornamental
Durable

Price $1.50
Delivered
Anywhere $1.75

WRITE FOR PARTICULARS AND PRICES

Crescent Company
401 Omaha Bldg., Chicago

The World's Headquarters for
ELECTRIC NOVELTIES AND SUPPLIES
If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3.00
Battery Hanging Lamp	10.00
Telephone, complete, $2.50,	5.95
Electric Door Bells	1.00
Electric Carriage Lamps	5.00
Hylo Turn-Down Lamps	.60
$8 Medical Batteries	3.95
$12 Belt, with Suspensary	2.50
Telegraph Outfits	2.25
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights	3.00
Electric Railway	2.75
Pocket Flash Lights	1.50
Necktie Lights 75 cents to	3.00

SEND FOR FREE BOOK

$3 Electric Hand Lantern — Agents Wanted

OHIO ELECTRIC WORKS . . . Cleveland, Ohio

ELECTRICAL BARGAINS

"Magic" Search Light (like cut)	$2.00
Vest-Pocket Light	1.50
Telephone, complete	2.50
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	90c. and up
Battery Motors	75c. to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Library Lamps	3.00
Electric Carriage Lamps	5.00
Electric Reading Lamps	5.00
Miniature Electric Railways	3.25
Electric Scarf-Pins	1.50

Our Free Catalog

describes many other electric novelties. We promptly refund money if dissatisfied.

AGENTS WANTED

These novelties sell on sight and are easily shown. Everybody is interested in some of them. We want good, live, responsible agents in every place, big or small, and there's an interesting proposition ready. All particulars for a postal.

J. W. SCRIBNER & CO., 161 Niagara St., Tonawanda, N.Y.

Telephones...

For Farm and County Lines.

Every Instrument Guaranteed.
A Full Line of Supplies.

GET PRICES

EMPIRE ELECTRIC SUPPLY CO.

55 West Jackson Blvd. CHICAGO, ILL.

THE SIGN LANGUAGE.

A farmer was going to town with a load of farm produce and was hailed by a friend and asked as to the contents of his wagon. Says he, "I have three-fourths of a square and a circle complete, a perpendicular on which two semi-circles meet, a right angle standing on two feet, two semi-circles and a circle complete."

The questioner began to make marks in the dust of the road and finally produced this

then looked up and smiled.

ELECTRICITY IN THE SERVICE OF MAN.

Modern Practical Electricity is the first work to give a complete and accurate account of the latest applications of electrical forces which seem to be transforming the industries and science of civilization. The work, carefully edited and handsomely illustrated with 1,000 pictures, tells of electricity in the service of man, and is written by one of the foremost authorities of the day—R. Mullineux Walmsley, D. Sc. (London) F. R. S. E. The author is principal and head of the electrical engineering department of the Northampton Institute, London, and late professor of applied physics and electrical engineering in the Herriot-Watt college, Edinburgh.

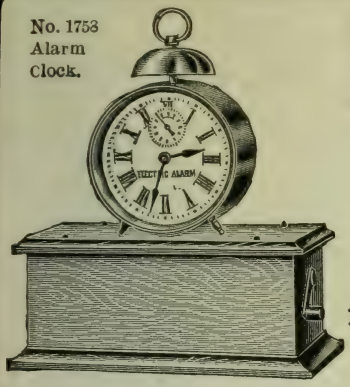
The work, which is in four splendid volumes, is a complete history of the electrical science, telling of the early and latest discoveries, inventions and adaptations. It is indispensable to all interested in the world's progress in this—the age of electricity, when electric railways and tramways are springing up on every side, when tube schemes promise a revolution in methods of locomotion; when telephones have permitted the talking across continents; when electric lights have turned night into day in our great cities; when automobiles have enabled men to travel in all parts of the country independent of the horse or railway; when wireless telegraphy wings words on the air across the ocean; when the X-ray renders opaque substances transparent and permits the eye to penetrate the interior organs of animals, and when a hundred things that would have been regarded as miracles a few years ago, are now looked upon as every day matters of course. All these things are related entertainingly in Modern Practical Electricity. Price $3 per volume, published by W. T. Keener & Co., 90 Wabash avenue, Chicago.

BETTER TELEGRAPH OPERATORS NEEDED.

It is now stated that the standard of efficiency of railroad telegraph operators is not nearly so high as a few years ago. It is also claimed that many of the accidents growing out of mistaken train orders are due to this fact. The attempt to transmit rapidly which is a feature of modern instruction in telegraphy also contributes to errors.

WHEN YOU WANT ANYTHING
AND DON'T KNOW WHERE TO FIND IT
WRITE POPULAR MECHANICS

No. 1753 Alarm Clock.



Electrical Novelties and Supplies

SPECIAL NET PRICES

No. 1561. Short line telephone, Ea. @$2.50
2204. Home Medical Apparatus - - - " 3.25
2215. Anti-Doc. Medical Apparatus - - - " 2.00
2240. Little Giant Medical Apparatus - - - " 1.35
1762. Electric Door Bell Outfit, complete - - - " .55
Eureka Pocket Flash Lights " 1.25
Mesco Dry Batteries @10 1-2c.
178. Eureka Telegraph Instruments - - - " 1.00
3 inch Iron Box Bells - - " .16

No. 18. Annunciator Wire, per lb. - - - Ea. @$0.22

Long Distance Bridging Telephones

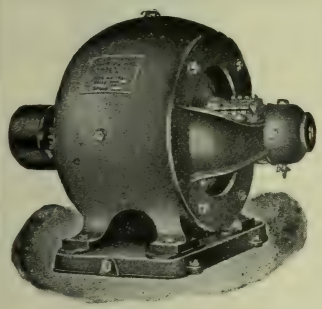
With 1600. Ohm Ringers, 50,000 Ohm Generators, fully guaranteed, complete Ea. @$11.00
Same with 100,000 Ohm Generators - - - " 12.00
1758. Early Riser's Electric Alarm Clock - - - " 1.90
We have many other equally as attractive prices to offer.

SEND FOR NO. 16 CATALOGUE

MANHATTAN ELECTRICAL SUPPLY CO.

The Largest Manufacturers and Dealers in Electrical Supplies in America

32 Cortlandt St, 39 Dey St., New York 200 5th Ave., Chicago



Electrical Construction.....

DYNAMOS, MOTORS, METERS
ARC LAMPS, SWITCHBOARDS
RHEOSTATS and WIRING

Repairing of all kinds

N. W. YOUNG, 52 West Adams Street, **Chicago**

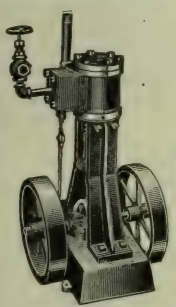
Telephone, FRANKLIN 231

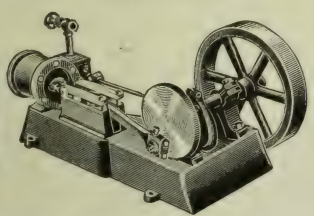
BE YOUR OWN ENGINEER

We Can Furnish You With

ENGINES

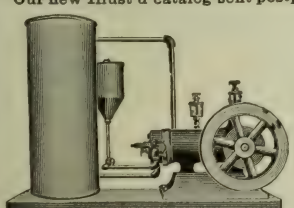
1-8 H. P. UP.





Steam Boilers, Steam Pumps, Steam Engines, Gas and Gasoline Engines

For Stationary, Marine and Automobile use. Dynamos, Motors, Electric Fans, Electric Novelties, Batteries & Supplies, Individual Electric Lighting Outfits, 8 to 100 Light. Our new Illust'd catalog sent postpaid 6c.



MARTIN MFG. CO. 180 W. Madison St., CHICAGO

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St., CHICAGO

In the Pay Envelope

IS WHERE OUR TRAINING AFFECTS YOU

It is not hard to obtain a larger salary if you know enough to be worth it to your employer. We have trained thousands of people for larger salaries and more congenial occupations. If you wish to increase your earnings, or change your occupation, we can help you through the I. C. S. system of training by mail. We can qualify you, in your spare time, for a position as a Stationary, Steam, Electrical, Mechanical, or Bridge Engineer, Architect, Surveyor, Bookkeeper, Stenographer, Ad Writer, Show-Card Writer; and for the Civil Service Examinations.

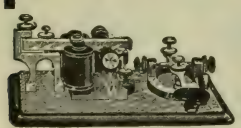
Tell us which position interests you. We will send you full particulars, and free booklet, "1001 Stories of Success."

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 827, Scranton, Pa.

LEARN TELEGRAPHY AT HOME

No Fees to Pay. Learner's Set and Instruction Book $1.75



Salaries $60 to $150 a month. Any boy or girl can learn. Two instruments like cut, 50 ft. wire, 2 dry cells, $4.25. Best Dry Batteries 30c each.

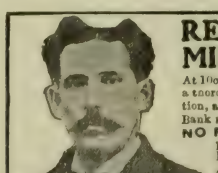
ELECTRIC NOVELTY CO.
16 E. Market St., Indianapolis

TELEGRAPHY

Telegraphers' Penmanship and Typewriting
COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.



RESILVER OLD MIRRORS

At 10c each—brings you $5. We give you a thorough, practical course of instruction, and guarantee you success at once. Bank reference, also many of our students. NO RECIPES, but a thorough, complete instruction in over 20 Money-Making Methods for the Painter, Agent or Mechanic. Send stamp for booklet. Address Hullinger's Correspondence School, Francesville, Ind.

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

THE "DEATH DICE."

The German emperor has presented to the Hohenzollern museum the "death dice," with which one of his ancestors decided a difficult case in the seventeenth century. This is their history, told by the Tatler.

A young girl had been murdered. Suspicion fell upon two soldiers, Ralph and Alfred, who were suitors for her hand. Both the accused men denied their guilt, and even torture failed to extract a confession from either of them.

Then Elector Frederick William decided to cut the knot by means of the dice-box. The two soldiers should throw for their lives, and the loser should be executed as the murderer. The event was celebrated with great pomp and solemnity.

Ralph had the first chance and threw sixes, the highest possible number. The dice-box was then given to Alfred. He fell on his knees and prayed aloud.

Then he rose to his feet, and threw the dice with such force that one of them broke. The whole one showed six, the broken one also gave six on the larger portion, and the fragment split off showed one. This was a total of thirteen, one beyond Ralph's throw. The audience held its breath in amazement.

"God has spoken!" cried the prince.

Ralph, appalled by what he regarded as a sign from heaven, confessed his guilt and was sentenced to death.

WOOD AS HARD AS IRON.

There is reposing in the lumber shed of one of the navy yards a stick of lumber that is worthy of the attention it is receiving from the old-time sailors and navigators. It is a piece of live oak, 37 feet long, 4 feet 10 inches wide and a little over 4 feet thick, and has become so hard with age that it requires the finest grade steel to make any impression on it. Its weight is estimated as between twelve and thirteen tons. The stick was originally designed for the stern post of a sister ship to the Hartford, but for some reason was never used. Some of the old tars want the stick cut and sent to a woodworking shop to be turned into pillars to be used in the corridor leading to the officers' quarters on the new battleship Connecticut.

HE CARRIED THE FLAG.

An American who recently took charge of a division of a Mexican railway relates the following incident, which occurred on his first trip of inspection over the line.

The inspection car came up to a trackwalker, who had a wrench in one hand, a machete hung over his shoulder, and carried a green flag in the other hand.

As soon as I saw the green flag he carried I stopped my car and asked him, "Do you work for this company?"

He answered, "Si, Senor" (yes, sir).

"What is your position with the company?"

"I am trackwalker, sir," looking very wise.

"A trackwalker, then, is an official of the road?"

"Si, Senor."

"What is your duty?"

"Oh, nothing, only walk up and down the track."

"What is that you have on your shoulder?" indicating his green flag.

"That is a flag, sir."

"What do you do with that flag? Do you ever use it?"

"No, sir, I never use it."

"Do you know why you are told to carry a flag?"

"No, sir."

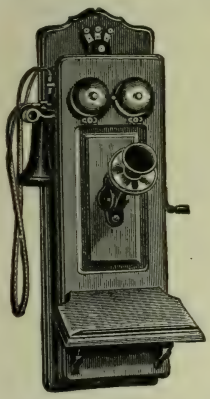
"If you don't know why you carry the flag what is the reason that you carry it at all?"

"Well, my foreman told me to carry it, and I am going to carry it."

Attorney-General Cunnen has received a communication from a man in Michigan, who inquires whether electrocution is an effective punishment for the crime of murder. The attorney-general in reply stated that so far as he is aware no man who has suffered that punishment ever again committed murder or any other crime.

Russia has 84,544 public schools, half of which are under the direction of the church. There are 4,400,000 pupils which cost per head, $9.50 for city and $5 for village pupils, per year.

THE
QUESTION OF QUALITY
in
Telephones
is
Satisfactorily
Answered

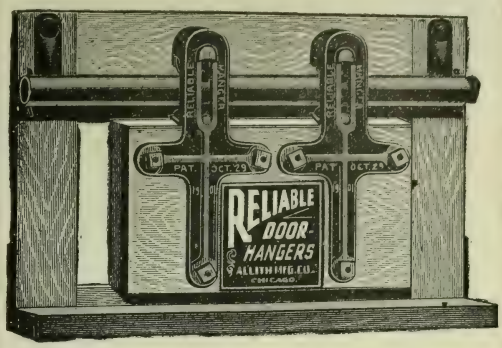


Our instruments are the best that long experience, skilled workmen and a complete equipment can produce. Our prices are the only cheap thing we offer. Let us send you a catalogue that tells all about the best Telephones for Rural Lines and Short Private Lines.

Acme Electric Co.

200 S. Clinton St. - Chicago, Ill.

The "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks.
Ours Will Not Bind.
Ours Cannot be Derailed.

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.
120 South Green Street
CHICAGO

The mechanical principles that have been proven best in all typewriters find concrete expression in the Standard

CHICAGO TYPEWRITER

$35.00

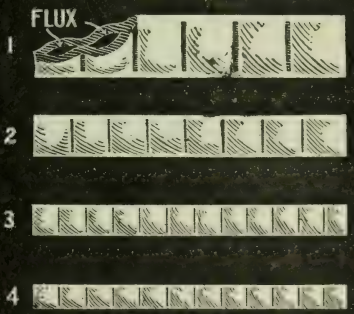
This almost human piece of mechanism exceeds the capacity of the most skilled fingers

CHICAGO WRITING MACHINE CO.
76 WENDELL STREET, - CHICAGO

KESTER Self-Fluxing SOLDER

Saves Labor--Time--Money

A TUBE OF SOLDER FILLED WITH FLUX



ACTUAL SIZE

PATENTED JULY 11, 1899
IN UNITED STATES, CANADA, ENGLAND
GERMANY AND FRANCE

Requires no Acid. Made With Various Fluxes
SEND FOR FREE SAMPLE

KESTER ELECTRIC MFG. CO.
253 So. Jefferson St., Chicago, Ill.

BOOKS SEND FOR OUR LIST OF LOW PRICES
Electrical and Mechanical Books
SPON & CHAMBERLAIN
Dept. P. M., Liberty Bldg., New York

BRASS BAND
Instruments, Drums, Uniforms. Lyon & Healy "Own-Make" Instruments are preferred by Thomas Orchestra, Banda Rossa, Mascagni, etc. Lowest prices. Big Catalog; 1000 illustrations; *mailed free;* it gives instructions for amateur bands.
LYON & HEALY, 2 Adams St., Chicago

Agents Wanted
WEBSTER'S VEST POCKET PRONOUNCING DICTIONARY
Rules for spelling, etc. 194 pages, size 5½ x 2½ in. Full leather; gilt edges; indexed, sample postpaid, 25 cts. Will send free full particulars of Argument Settler, Writing Desk Book, Dictionary and other Vest Pocket Editions. For terms, address,
GEORGE W. NOBLE, Publisher,
602 Lakeside Bldg. Chicago.

Electrical Books and Novelties
CATALOGUE FREE
Bubier's Popular Electrician, 50 cents per year; sample copy, 5 cents post paid; eight books 10 cents each. How to make a Dynamo, Motor, Electric Bell, Telegraph Instrument, Induction Coil, Telephone, Storage Battery, Talking Machine. Fully illustrated, **TEN CENTS EACH.** Dynamo and Motor Castings.
BUBIER PUBLISHING CO., Box P, Lynn, Mass.

CEMENT BOOKS
DO YOUR OWN CEMENT WORK
Full information in the following books:

"How to Use Portland Cement"	Price $ .50
"Portland Cement Sidewalk Constructions"	" .50
"Architects' and Engineers' Hand Book of Reinforced Concrete Constructions"	" 2.00

Delivered free on receipt of price. Address
Cement & Engineering News, 164 La Salle St., Chicago, Ill
Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE

W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

3 MONTHS FREE
Send us your name and address and we will send you The Investor's Review for three months free of charge. A great journal of advice for everybody. Fully illustrated. Gives latest and most reliable information concerning industrial, mining, oil and other stocks and enterprises. Knowledge is power. Great opportunities come and go. Great fakes likewise. Get posted before investing. Write today.
INVESTOR'S REVIEW, 1461 Gaff Bldg., CHICAGO, ILL.

PROPER METHOD OF BOILING WATER.

Few people know how to boil water properly, although it has much to do with the quality of the beverages for which it is used. Above all fresh water should be used. Have the kettle warm before putting in the water and the fire so quick that the water boils almost instantly. Remove the water as soon as it reaches boiling point, though if the water looks suspicious, five minutes' boiling will be necessary to kill the germs.

"MODERN GROCERIES."

Boracic acid in the soup,
Wood alcohol in wine,
Catsup dyed a lurid hue
By using aniline;

The old ground hulls of cocoanuts
Served to us as spices;
I reckon crisp and frigid glass
Is dished out with the ices.

The milk—the kind the old cow gives
Way down at Cloverside—
It's one-third milk and water, and—
And then—formaldehyde.

The syrup's bleached by using tin,
And honey's just glucose,
And what the fancy butter is
The goodness gracious knows.

The olive oil's of cotton seed,
There's alum in the bread;
It's really a surprise to me
The whole durned race ain't dead.

Meantime all the germs and things
Are buzzing fit to kill;
If the food you eat don't git you,
The goldarned microbes will.
—New Orleans Times-Democrat.

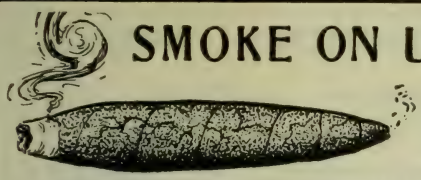
WITH US TO THE END.

Robert Dewhurst, of Bridgewater, Mass., in renewing his subscription writes: "I wish to say I trust to be with you to the end. I have seven boys and two girls and when Popular Mechanics comes they all want it."

ROPES FOR FUNERALS IN CINCINNATI.

In Cincinnati, recently, the thick coating of ice on the hillsides made travel so perilous that a unique scheme was adopted in the case of a funeral. The steep street leading to the residence was a glare of ice and vehicle travel over it was impossible. No attempt was made to take the carriages for the mourners up the hill, and the mourners had to walk to the bottom of the hill to take the carriages. The hearse was another matter. It was taken to the door, and when the casket containing the body had been placed inside, the hearse was let down the hillside by heavy ropes. Even then it required hard work, on the part of those who held the ropes, to prevent an accident.

Dr. William James Morton, the eminent New York physician, claims to have effected three complete cures of cancer by radium, and that two more cases now being treated will doubtless be cured. He said that one of the methods of radium cure of cancer or other diseases internally located is by what amounts to giving the patient liquid sunshine taken internally, or bathing the patient's interior with the rays of sun condensed into liquid form and liberated by the action of radium.



SMOKE ON US

50 CIGARS SENT ON APPROVAL

If they don't suit you, send them back at our expense. Here's our proposition in a nutshell. A 10-cent cigar for 5 cents, yourself to be the judge of the truth of our statement.

How can we do that? By cutting out profit of wholesaler, jobber and retailer.

The difference between what you pay the retailer and what you pay us—buying direct from the manufacturer—represents a

SAVING OF FIFTY PER CENT

Think you would like to test the truth of this? Send us your name and address, enclosing your business card, and we will send you fifty cigars on approval. If you like them—all right. Send us $2.50 for the box. You're a steady customer. If you don't like them, after smoking five, return the remainder at our expense. You're five cigars ahead. That's fair, isn't it?

La Crutineza Cigar is the best and most popular brand of HAVANA CIGARS on the market, made from the finest Cuban tobacco, and positively unexcelled.

Now don't put this off. Write us to-day, enclosing your business card or stationery, stating whether you prefer mild, medium or strong. You'll be glad you did

Circular and Price List Upon Application

LA CRUTINEZA CIGAR CO.

182 Dearborn St., Chicago, Ill.

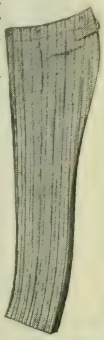
Send No Money

We want you to examine and try on our **$10.00 All Wool Tailor Made Suits** before paying out one cent, and know for yourself that our suits are strictly **All Wool**, properly tailored and perfect fitting. You will find them as good in every respect as suits you have paid $13.00 to $15.00 for.

10,000 Pair of $5.00 Tailor Made Trousers **FREE**

with the **first 10,000** orders.

Our Offer: **Providing** you will agree to hand 10 envelopes containing our **All Wool Suit** and **Pant** samples, catalogue, tape measure and **Special Offer** to ten men who in your judgment would be likely to buy clothing from us on our **liberal offer, we will give you a pair of our regular $5.00 Tailor Made Trousers**, any pattern you may select from our samples



FREE

with one of our **$10 All Wool TAILOR MADE SUITS.**

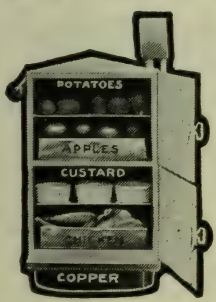
We make your suit and trousers exactly as ordered and send them to your express office for you to examine and try on. If you find them both as offered, pay the express agent $10. and the express charges, and both the All Wool Suit and the extra pair of $5. Trousers are yours. The ten envelopes you are to distribute will be sent in the box with your suit. Read this offer overagain carefully, then write today for free samples of our $10. Suiting, (including Clay Worsteds, Thibets, Serges, Cassimeres in Black, Blue, Brown, Grey and Handsome Mixtures;) also separate trouser samples, Catalogue, instructions for taking measurements and Special Offer. Remember we run all risk.

Reference: Milwaukee Ave. State Bank, Chicago. Capital Stock $250,000.

O. T. Moses & Co. 230 Moses Bldg. Chicago

DON'T STAND OVER A HOT STOVE

Make Summer Cooking a Pleasure by Using



O-HI-O Steam Cooker

WITH TWO DOORS

PRICES, $2.50 TO $9.50

ADVANTAGES

1. Cooks entire meal over one burner, any style stove.
2. **Saves 50 pr cent** in fuel.
3. Food CANNOT be burned.
4. Food always steaming hot.
5. Food not spoiled by waiting meal.
6. **Saves 50 per ct. in food**
7. Meats always tender. No evaporation.
   Saves 25 per cent. in meat bills.
8. Steam cooked food always easily digested. Cures dyspepsia.
9. **Saves 50 per cent in doctor's bills.**
10. Cooker once filled will cook entire meal from soup to dessert without further attention. Can't overcook.
11. **Saves 50 per cent in labor.**
12. **Takes the place of a cook or makes a good cook out of a poor one. No mistakes.**

FINE FOR SUMMER COTTAGES

GRAND FOR CANNING FRUIT

Handsomely Illustrated Catalog Free

WE WANT GOOD AGENTS and will guarantee them $30 to $40 per week and expenses. Write now and start in business for yourself before your territory is given to another.

THE OHIO COOKER COMPANY

759 Jeff Avenue, Toledo, O.

AND THEY OUGHT TO BE DEHORNED

The Calves Are Coming

The Humane Dehorning Stick is the best thing on the Market.

THE Humane Dehorning Stick

The only satisfactory method of dehorning cattle. Better than clippers, knife, saw or liquid. Is a chemical preparation in stick form.

BECAUSE it is SAFER and not cruel. Leaves a nicely formed head.

NO **SHOCK TO THE ANIMAL.**
LOSS OF BLOOD.
LOSS OF FLESH.
SET BACK.

One Stick Will Dehorn 75 Calves

and is absolutely sure. Simply rub the end of the stick on the embryo horn and the work is done.

Price $1.00 per stick Postpaid

Full directions with each package.

E. G. SHERMAN
Dept. D
99 Randolph St.
Chicago

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HARWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. patent office to enter this firm. Address
210 Revenue Building . . WASHINGTON, D. C.

PATENTS

promptly obtained OR NO FEE. Trade-Marks, Caveats, Copyrights and Labels registered. TWENTY YEARS' PRACTICE. Highest references. Send model, sketch or photo. for free report on patentability. All business confidential. HAND-BOOK FREE. Explains everything. Tells How to Obtain and Sell Patents, What Inventions Will Pay, How to Get a Partner, explains best mechanical movements, and contains 300 other subjects of importance to inventors. *Address,*
H. B. WILLSON & CO. Patent Attorneys
721 F Street West. WASHINGTON, D. C.

PATENTS

Skillful prosecution positively guaranteed. Rejected cases a specialty. Installments taken. Write for particulars. No charge for opinion as to patentability, etc. **$20.00**

THOS. A. HILL, Patent Attorney & Consulting Engineer
Main office: 261 Broadway, New York City
Skilled associates in Washington and abroad

PATENTS Protect Your Ideas
Consultation Free
Fee Dependent on Success
Established 1864
MILO B. STEVENS & CO.
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

A FREE BOOKLET FOR INVENTORS
Gives valuable information to those contemplating taking out American or Foreign Patents. It will save you money and time. Mailed free if you mention Popular Mechanics. Address
Robert Klotz & Co., Schiller Building., Chicago, Ill.

W. K. Stevens
(Estab. 1867)
Solicitor of American and Foreign **PATENTS**
Honest advice; honest service. My record—97 per cent successful cases. Booklet free.
1065 Virginia Ave. -- WASHINGTON. D. C.

PATENTS

HIGDON & LONGAN & HOPKINS
Missouri Trust Bldg., St. Louis, Mo.
Write us About Your Invention

PATENT NOTES.

A patent was recently issued to John McTammany, of Massachusetts, on a vote-counting machine. This is probably an improvement on the Tammany vote-counting machine of New York, but we doubt if it will prove as popular.

During the year 1903, 31,699 patents were granted by the United States, of which 3,763 were issued to citizens of foreign countries. Illinois inventors obtained 2,811 patents or one to every 1,715 residents of the state. One man out of every 997 residents of Connecticut obtained a patent. To residents of Massachusetts, 2,081 patents were issued, which is one to every 1,348 of that state. The number of patents is gradually increasing and the records of the Patent Office show that a larger proportion than ever are bought by manufacturing concerns and others who believe in patent rights as an investment. There is no bureau of the government in which such important work is transacted with so great fidelity as the Patent Office. Employes whose salaries range from $600 to $2,400 a year are intrusted with the care of inventions, the value of which is frequently in the millions, but notwithstanding the opportunity to take advantage of this information there never has been an instance in which a Patent Office employe has betrayed the special trust reposed in him. The notion that prevails among some inventors that they take risks in submitting their ideas to the scrutiny of the Patent Office Examiners, is wholly without foundation or reason. The law prohibits an employe of the Patent Office from taking out a patent on any invention the application for which was pending while he was in the Patent Office. Inventors have everything to gain and nothing to lose by filing their applications for patents in the Patent Office.

The successful inventor is the one who looks about him and takes note of the things that are popular and studies them with a view of finding where and how they can be made better or cheaper, or changed so as to increase their function or usefulness. Having hit upon or worked out what he thinks is an improvement, the first step is to find out whether it can be protected by a patent. Having found that a patent can be obtained he loses no time in making an application for a patent and goes to work at once to manufacture and put on the market the article, or to find some manufacturer or other person to join him in doing so.

'POP' HANDY IN THE SMALL SHOP

"Popular Mechanics has been a great help to me, as I have a small steam plant, and being a young man just starting into business, I found many ways of doing my own repair work. I advise any one having an engine or motor to take your paper, for that use if no other. Yours respectfully."—Fred. D. Johnson.

EXPERT IN ELECTRICITY MECHANICS PATENT CAUSES
SOLICITOR OF U. S. & FOREIGN **PATENTS**
FORÉE BAIN, 1652-3 Monadnock Blk., CHICAGO

H. J. TILLOTSON, M. D.
The Master Specialist of Chicago, who Cures Varicocele, Hydrocele, and treats patients personally
Established 1880.
(COPYRIGHTED)

VARICOCELE
HYDROCELE

Cured to Stay Cured in 5 Days
No Cutting or Pain. Guaranteed Cure or Money Refunded

VARICOCELE Under my treatment this insidious disease rapidly disappears. Pain ceases almost instantly. The stagnant blood is driven from the dilated veins and all soreness and swelling subsides. Every indication of Varicocele vanishes and in its stead comes the pleasure of perfect health. Many ailments are reflex, originating from other diseases. For instance, innumerable blood and nervous diseases result from poisonous taints in the system. Varicocele and Hydrocele, if neglected will undermine physical strength, depress the mental faculties, derange the nervous system, and ultimately produce complicated results. In treating diseases of men I always cure the effect as well as the cause. I desire that every person afflicted with these or allied diseases write me so I can explain my method of cure, which is safe and permanent. My consultation will cost you nothing, and my charges for a perfect cure will be reasonable and not more than you will be willing to pay for the benefits conferred.

Certainty of Cure is what you want. I give a legal guaranty to cure or refund your money. What I have done for others I can do for you. I can cure you at home.

Correspondence Confidential. One personal visit at my office is preferred, but if it is impossible for you to call, write me your condition fully, and you will receive in plain envelope a scientific and honest opinion of your case, Free of charge. MY HOME TREATMENT IS SUCCESSFUL. My books and lectures mailed free upon application.

H. J. TILLOTSON, M. D., 271 Tillotson Bldg., 84 Dearborn St., CHICAGO

An Ideal Strop For Private Use

Radiumite Razor Strop
(SELF HONING)

Endorsed by prominent army officers, bankers, professional men, business men and wage earners

PRICE, ONE DOLLAR
Sold Under Dollar-Back Guarantee

With this strop you can in a few strokes put the dullest razor into more perfect condition than can an expert on the finest hone. Radiumite, the wonderful new composition, is revolutionizing the art of shaving. Radiumite strops have handsome nickel and leather trimmings, with silk cord attachment for tourists. They are indestructible and never lose their wonderful honing and finishing properties. Price, one dollar each, with a dollar-back guarantee.

The Charles Albert Co,
110 DeKalb St, Suite 255 Chicago

RHEUMATISM
CURED THROUGH THE FEET

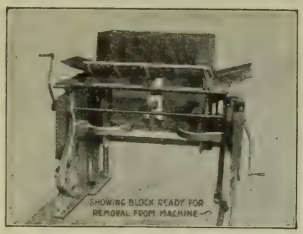
External Remedy so Successful that the makers send it . . . .

FREE ON APPROVAL TO ANYBODY. TRY IT

Send your name and address to the makers of Magic Foot Drafts, the great Michigan cure for every kind of rheumatism—Chronic or Acute, Muscular, Sciatic, Lumbago, Gout, etc., no matter where located or how severe. You'll get a pair of the Drafts by return mail—prepaid—FREE ON APPROVAL.

If they give relief, send ONE DOLLAR; if not, keep your money. You decide.

Magic Foot Drafts are worn without inconvenience and cure rheumatism in every part of the body by drawing out the poisonous acids in the blood through the great foot pores. You can see that this offer is proof of their merit, for hundreds of thousands of persons answer these advertisements, and only those who are satisfied with the benefit they receive, send any money. Write today to Magic Foot Draft Co., 451 Oliver Bldg., Jackson, Mich., for a trial pair and be cured. A valuable illustrated BOOK ON RHEUMATISM also sent free.



The WINGET CONCRETE

BUILDING BLOCK MACHINE

Patents Guaranteed. Any Size or Shape in **Hollow** or **Solid Blocks** required in ordinary building operations can be made on one and the same machine.

A. D. MACKAY & CO.
General Sales Agents,
Chamber of Commerce, : : : CHICAGO

The Mail Order Way The Only Way To Make Money

It is an inviting, legitimate and congenial business. Subscribe to the Mail Order Journal. In six years it has put hundreds next to making money. Three months' trial, fifteen cents.
LOUIS GUENTHER, Room 610 Schiller Bldg., CHICAGO

CHEAP RATES California, Washington Oregon, Colorado. We secure reduced rates on household goods of intending settlers to the above states. Write for rates. Map of California FREE.
TRANS-CONTINENTAL FREIGHT CO., 329½ Dearborn st., Chicago

GASOLINE TANKS

FOR AUTOMOBILES, MOTOR CYCLES AND ENGINES.

RADIATORS for Automobiles.
MUFFLERS for Motor Cycles.

Only first-class work.
Prices reasonable.
Satisfaction guaranteed.

EDW. C. FISCHER, Mfr.
977 Bradley St, ST. PAUL.

REMOVES MACHINE GREASE FROM FACE & HANDS.
Absolutely Harmless.

GRE-SOLVENT

Send 2c. Stamp for Sample Box.
The Utility Co., 231-235 Greenwich St., New York City.

ASTHMA Cured before you pay. We will send any sufferer a bottle of LANE'S MAGIC ASTHMA CURE **FREE.** If it cures you, send us $1.00; if it does not, don't. ☞ Give express office. Address
GUARANTY REMEDY CO., Dept. 14.688 Sedgwick St., CHICAGO

MARRY

WEALTH - BEAUTY
Marriage Directory **Free to All.** Pay when married. Entirely new plan. Send no money for particulars.
SELECT CLUB, Dept. 448, TEKONSHA, MICH.

JOHN KIOLA, General Engraver
Seals, Badges, Steel and Brass Stamps, Embossing Dies, Stencils, Plates, Etc.
Drop a Postal for Free Booklet Catalogue
R. 59, 155 W. MADISON STREET, CHICAGO, ILL.

A NEW METHOD OF COLORING PHOTOGRAPHS.

The following method of coloring photographs will give anything from good to best depending on the ability or patience of the operator, even the first attempt resulting in a charming picture, says a writer in the American Amateur Photographer. From a good negative, the simpler the subject the better, print on a piece of rollable film exactly as for a lantern slide; one or two trials will show to just what density the positive should be. Eastman's "N C" film answers admirably. Select a suitable backing paper of any delicate shade, although for many subjects white does as well as any kind of tint, and press them against one of the panes of the window, the film next the glass. On the paper draw roughly a pencil outline of the subject as a guide to the application of the color which may be laid on the paper with a free hand, the photograph giving all the beautiful shading. Bind them together, glass in front and cardboard behind, to keep the film flat, and the color will be found to show through the film with all the beauty of a painting by a good technical artist. I have not tried pasting the film and colored paper together, but think it might be an improvement.

WAR DECREASES COPPER SHIPMENTS OF JAPAN.

If Japanese miners are called upon for military service Japan's output of copper will be materially decreased and prices will go up. While Japan's output is small compared with that of the United States, it is still great enough to influence the market. The consumption of copper is 550 per cent of what is was thirty-four years ago, due greatly to the requirements of electrical engineering, and any decrease in the supply is certain to be felt.

HARVESTING ICE AND ORANGES.

One of the unique features of the Pacific Coast region is witnessed every winter in Nevada county, a little north and east of Sacramento, where a big ice crop has been harvested at Truckee, and within a few miles a big orange crop gathered, both harvests going on at the same time. Nevada county is one of the smallest counties in California, but at Truckee, which lies at an elevation of about 6,000 feet, sleighing, skating and ice cutting were the order of the day during January, while 5,700 feet below strawberries, oranges and roses were being picked, these so widely separated occupations being carried on by the participants almost in sight of one another.

MILLIONS OF RABBITS EATEN.

Rabbits are a terrible pest in Australia. Each year at the "round-up" millions of them are slaughtered. Even pests may be profitable, however, for now the rabbits are being shipped for their fur and meat.

John P. Bray, Consul General at Melbourne, Australia, says: "This industry has become an important one in Australia. Over 20,000,000 rabbits were utilized during the year for export purposes. Of these 1,300,000 were exported frozen in the fur and from 10,000,000 to 12,000,000 skins were shipped and a large number of these animals canned and disposed of."

Send for Popular Mechanics New Premium List.

Insure Your Motors

BY USING

PEERLESS COMMUTATOR COMPOUND

No Grease — No Graphite
No Oil — No Tallow

DOES NOT GUM

Send One Dollar Trial Order.
Distributing Agents Wanted.

Peerless Manufacturing Co., : : New Orleans, La.

COPPER

LIGHTNING RODS

WEATHER VANES
TOWER ORNAMENTS
CHURCH CROSSES
COPPER FINIALS, etc.

80 page Illustrated Catalogue mailed free
T. W. JONES, Mfr., 18 Fletcher St., N. Y. Est. 1862

J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing
165-167 Dearborn St. Chicago

MARK YOUR NAME on your TOOLS, etc.

Price per letter for Steel Stamps		
SIZE OF LETTERS	INITIAL STAMP	NAME STAMP
1-16 in.	18c.	14c
1-8 in.	18c.	14c.
3-16 in.	23c.	18c,
1-4 in	35c.	28c.

SEALS $1.70 WITH A **Steel Stamp**

WILLIAM SCHRIDDE,
Engraver and Die Maker
35 S. Clark St. Chicago, Ill.

C. H. HANSON
MANUFACTURER OF
MACHINE PLATES
44 SO. CLARK ST.
CHICAGO

NAME PLATES, STEEL DIES
SEALS and STENCILS
C. H. HANSON, 44 So. Clark St.
Chicago

HOW TO MAKE

Electrical Instruments

Chapters of "Easy Electrical Experiments," which have been printed in Popular Mechanics as a serial, are for sale to close out all back numbers. All the chapters are complete, describing the instrument named in the list below. Sent postpaid on receipt of price.

Thousands of Popular Mechanics readers have made these instruments from the descriptions which are given in plain, simple language, "written so you can understand it." Directions are fully illustrated. Money (or stamps) must accompany order.

TELLS HOW TO MAKE

No.	Parts.	Cents.
1—Simple Galvanometer	1	5
2—Box to Hold Battery	1	5
3—Tangent Galvanometer	1	5
4—Powerful Magnet	1	5
5 Electric Circuit of Water	1	5
8—Measurement of Resistance	3	10
9—An Electrophorus	1	5
10—Electric Condenser	1	5
		10
12—Rheostat	3	10
13—Electric Bell	3	10
14—Electric Plating at Home	3	10
16—Electric Engine	1	5
17—Electric Gyroscope	3	10
18—Electric Locomotive	1	5
19—Model Fire Alarm Telegraph	2	10
20—Electric Bomb	1	5
21—Automatic Circuit Closer	1	5
22—Electrically Lighted Lamp	1	5
23—Simple Arc Lamp	1	5
24—Experimental Battery	1	5
25—Portable Voltmeter	3	10
27—Sensitive Galvanometer	1	5

ORDER BY NUMBER

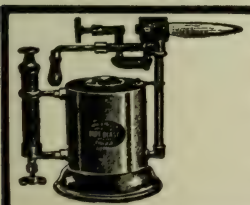
Address

POPULAR MECHANICS, Journal Bldg., CHICAGO

DEVICE FOR SOLVING HARD PROBLEMS

Would you like to add 1-117th to 36-81sts and then subtract 5-11th without ever touching a pencil? Would you like to do so as quickly as you have read these words, and know the result will be absolutely correct, that it is simply impossible to make a mistake? Such a device has been perfected, and is called a Tractometer; it will prove a special boon to draftsmen, mechanics, engineers and all who use fractions. The thousands of combinations in fractions up to 128ths can all be instantly worked by a simple turn of the disc, and so easy to understand that a ten-year-old boy can solve the most difficult additions and substractions that any professor in mathematics may impose.

When you want anything and don't know where to find it, write Popular Mechanics.



Special Brazing Tools for All Mechanical

purposes, from 1 quart to 10-gallon capacity, from a needle point flame to a brush flame 3 inches in diameter. There is no limit to the work that may be accomplished with our tools : : : : : : :

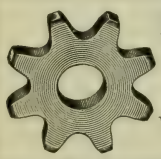
WHITE MFG. COMPANY
205 Michigan Street, CHICAGO
WRITE FOR CATALOGUE AND DISCOUNT.

Please mention Popular Mechanics when writing advertisers.

SUPPLIES
DIRT CHEAP
Write for Catalogue and Green Discount
THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly..
$2.00 a Year
WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.

MOTORS
$5.00 Buys a
COMPLETE PRACTICAL BATTERY MOTOR—Not a Toy
WALSH'S SONS & CO.
250 Washington St. - Newark, N. J.


SPROCKETS
and EQUALIZING GEAR
IN STOCK OR TO ORDER.
We can save you money. No order too small or too large. CATALOG FREE.
CULLMAN WHEEL CO., 521-525 Larrabee St., Chicago

Every Bicycle a Motor Cycle

by using one of our ATTACHABLE MOTOR outfits. Thoroughly practical. Can be applied to any wheel. On the market four years. Also Motors and Castings for Bicycle, Automobile, Marine or Stationary. LOWEST PRICES. 2-cent stamp gets our catalogue.
STEFFEY MFG. CO., Brown & Pennock Sts., Philad'a, Pa.

I Positively Cure

Sparking, Humming, Cutting, etc., of Commutators and Brushes
Write me, giving full description of your trouble, style of machine, load carried, and I will send you treatise on same
FREE OF CHARGE
J. S. HART, M. D. & D. D., - Monadnock Building, Chicago
(Doctor of Motors and Dynamos)

THE WORLD'S COAL PRODUCTION.

Official statistics show the total annual production of coal of the world to be 700,000,000 tons. The long ton of 2,240 pounds is used in this calculation. In 1902 the United States produced 269,195,000 tons; the United Kingdom of Great Britain, 227,095,000 tons; Germany, 150,600,000 tons; France, 29,574,000 tons and Belgium 22,769,000 tons. America's output was valued at $371,927,000 and the United Kingdom's at $467,605,000. In the United States the average number of miners employed in the production of coal was 518,307, and the average yearly production per miner was 520 tons. Great Britain employed 805,100 miners, the average production of each being but 278 tons. The average production of Germany's miners was 242 tons each, of France's 198 tons and of Belgium's 166 tons. Thus it is shown that the American can mine nearly twice as much coal as the British miner, more than twice as much as the German, nearly three times as much as the French miner and more than three times as much as the Belgian. The United States consumed 265,612,000 tons of coal in 1902, while Great Britain consumed 166,698,000 tons, Germany 146,370,000 tons, France, 42,199,000 tons, and Belgium 19,691,000 tons.

Japan's exports were nearly 3,000,000 tons greater than her imports. It is estimated that more than a billion tons of coal are deposited in the undeveloped coal fields of Hokkaido, one of the northern islands of Japan.

COST OF TRANS-SIBERIAN RAILWAY.

The construction of the great Trans-Siberian railway, comprising 5,995 miles, has cost $484,554,415, or an average of $53,553 per mile.

NEW SYSTEM OF MEASURING CRIMINALS.

The police of London have introduced experimentally a new measuring system for recognizing criminals. As it has been successful, it will soon be adopted by a number of other police departments both in England and abroad. In this system only the impressions of the fingers are taken. Compared with the "Bertillon" system, it has, above all, the advantage of simplicity, as it can be applied without any contrivances, and is, therefore, much less expensive. Whether it can completely take the place of the Bertillon system remains to be seen. The Berlin police have for the present also inaugurated a card collection of impressions of the fingers for recognition purposes. The new system is called "Daktyloscopy."

WHY OYSTERS CAUSE TYPHOID.

Investigation has shown that oysters eaten raw frequently cause typhoid. Not the thin, grayish oysters, fresh from the briny deep, but those which, in consequence of the consumer's demand that the bivalve be good to his sight as well as to his perverted taste, are subjected to a bleaching process which makes them plump as well.

To secure this appearance the salt-water product is placed in fresh water, frequently in fresh-water streams. This bleaches them and owing to the fact that nowadays few fresh-water streams are pure; that the oyster absorbs so much water that it appears plump, and that its digestive functions are retarded by the unnatural conditions, any bacilli in the water absorbed rapidly multiply, thus infecting the oyster.

This infected food, often shipped long distances, becomes a menace to the health of whole communities. This practice of bleaching and fattening the oyster certainly should be discouraged by epicureans and consumers in general.

THE AZTEC PLANTATION COMPANY

paid its first dividend of 5 per cent on May 1, 1902; its second dividend of 7 per cent on May 1, 1903, from the products of corn: it will pay its third dividend of at least 7 per cent on May 1, 1904, from the products of corn and sugar cane.

The Company's sugar mill—of capacity to handle the product of 1000 acres of cane, has been purchased, paid for and shipped to its plantation, located on the navigable Uspanapa River, Isthmus of Tehuantepec, with four miles river frontage—will be in operation to manufacture into sugar the crop that matures the end of this year.

Its first crop of matured cane is being harvested and marketed and will furnish the earnings for the dividend of May 1, 1904. 800 acres are being planted to sugar cane, and 200 acres to rubber.

Average product per acre of cane will be at least 50 tons, yielding 10,000 lbs. of sugar worth 10 cents per pound, Mexican	$1.000.00
Value of the by-products per acre	90.00
Total value per acre	1,0.0.00
Less running expenses, 2½ cents per pound	250.00
Leaving a net profit per acre, Mexican, of	840.00

Only a limited number of Plantation Certificates remain for sale at the price of $300 each, either for cash or on monthly payments. Dividends of 7 per cent per annum are guaranteed from date of purchase. Earnings in excess paid as extra dividends. These certificates are secured by deed of land, sugar mill and all the improvements thereon, unencumbered to the Royal Trust Company in trust for all investors alike, **FOR COMPLETE INFORMATION ADDRESS**

AZTEC PLANTATION CO., Suite 901, 59 Clark Street, CHICAGO, ILL.

CRANE VALVES

ESTABLISHED 1855

$33 to the Pacific Coast

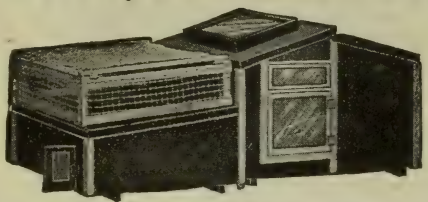
From Chicago, every day in March and April, 1904. Only $33 Chicago to San Francisco, Los Angeles, Portland, Seattle, Tacoma, and many other points on the Pacific Coast. Low rates to hundreds of other points. Choice of routes if you select the

Chicago, Milwaukee & St. Paul Railway

Tickets good in tourist sleeping cars. Rate for double berth, Chicago to California, only $7. Write to-day for complete information.

F. A. MILLER,
General Passenger Agent **CHICAGO**

TWO BROODERS IN ONE



THE TWO-STORY BROODER

Both floors heated by one lamp—contains 25 square feet of floor space, simple to operate, well constructed. Investigate. Illustrated Catalogue Free.

The Two-Story Brooder Co.
161 LA SALLE ST., CHICAGO, ILL.

THIS ONE SAVES YOU

Write today for **Free Catalog** and **Poultry Book** describing **NEW IDEA INCUBATOR.** Most durably built, best regulator, heater, lamp tanks, etc. Complete at only two-thirds cost of other high-grade machines. Write today. Address **CHANNON, SNOW & CO. Box 162 Quincy, Ill**

1/3

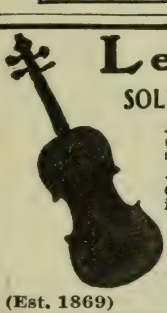
I J. F. Siems, want every one to know all about the

Natural Hen Incubator

and will be greatly pleased to send our **catalogue,** telling all about it, together with a **25c Lice Formula Free of charge** if you send us your address. Only plan totally different from all others. 200 egg hatcher only $3. Agents wanted everywhere, either sex. No experience necessary. Secure your territory at once. Address

NATURAL HEN INCUBATOR CO., Box B- 27, Columbus, Neb.

Lewis Violins



SOLD DIRECT, $3.50---$62.50

At half of dealer's prices. We prove it by sending any instrument on **TEN DAYS' TRIAL**

Also Banjos, Guitars, Mandolins

Our pocket dictionary of musical terms invaluable for reference, regular price 25c sent FREE if you state instrument you play, and send names and addresses of 4 or 5 friends stating instrument each plays.

Catalogue Free

WM. LEWIS & SON

(Est. 1869) **211 Wabash Ave., Chicago**

This ELEGANT Watch $3.75

Before you buy a watch cut this out and send to us with your name and address, and we will send you by express for examination a handsome **WATCH AND CHAIN C. O. D. $3.75.** Double hunting case beautifully engraved, stem wind and stem set, fitted with richly jeweled movement and guaranteed a correct timekeeper; with long Gold plated chain for Ladies or vest chain for Gents. If you consider it equal to any **$35.00 GOLD FILLED WATCH Warranted 20 YEARS** pay the express agent $3.75 and it is yours. Our 20 year guarantee sent with each watch. Mention if you want Gents' or Ladies' size. Address

H. FARBER & CO., A55, 23 Quincy St., CHICAGO.

PLAYS

FOR AMATEURS OR PROFESSIONALS; also Self-Educational Books on Amusements, Reference, Mechanics, etc. at popular prices. Send for our Illustrated Book Catalogue. Sent FREE to any address.

FREDERICK J. DRAKE & CO.
211 E. MADISON STREET, CHICAGO, ILL.

Typewriters all makes

All the Standard Machines SOLD or RENTED ANYWHERE at HALF MANUFACTURERS' PRICES allowing rental to apply on price. Shipped with privilege of examination. Write for Catalogue

TYPEWRITER EMPORIUM, 202 LaSalle St. Chicago

CYANIDE OF CACODYL THE DEADLIEST POISON KNOWN.

Fumes From Three Grains Would Kill Every Person in a Vast Audience.

A thousand times more poisonous than prussic acid, the most poisonous substance known heretofore, is cyanide of cacodyl, with which experiments were recently conducted in London by Lascelles Scott of Little Isford. One millionth part of a grain of the drug in the atmosphere of an air-tight cage killed a dog instantly. Its power not diminished, a second, third and fourth dog were killed in the same manner. A whiff of this most deadly poison would kill a whole room full of people. The vapor from three grains diffused into the air of the Metropolitan Opera House of New York or the Auditorium of Chicago would kill every person in the audience.

By scientists the poison is termed "di methyl arsine cyanide." It is a white powder which melts at 33 degrees and boils at 140 degrees. When exposed to the air it gives off a slight vapor which is death to inhale. It is claimed that the poison was first made many years ago by Cadet, a famous French chemist, by combining acetele potassium with white arsenic. The mixture produced a fuming liquid which, although the Frenchman did not know it, was oxide cacodyl. The German chemist Bunsen, combined this with cyanogen, a radical of prussic acid, and made cyanide of cacodyl.

The Baldwin Locomotive Works turned out 2,022 complete locomotives during 1903, which is 33 1-3 per cent in excess of the output of 1902. In addition to this, duplicate repair parts were furnished which were equivalent to 250 other locomotives. Of the completed locomotives 1,996 were for service in the United States. The value of the output was between $27,000,000 and $28,000,000.

E. H. Harriman and Julius Kruttschnitt, on behalf of the Southern Pacific Railway Company, have agreed to join the Rock Island in spending $1,000,000 for a causeway 500 feet wide, with concrete retaining walls, from the mainland across the bay back of the city of Galveston to the city.

The price of platinum is now about equal to that of gold.

Some people say Popular Mechanics is the best magazine published.

Negotiations for a settlement of the Gould-Pennsylvania controversy, which culminated in the chopping down of the Western Union telegraph poles along the Pennsylvania Railroad lines, have been resumed, with prospects of a settlement to mutual advantage.

Popular Mechanics will greatly appreciate any photographs of curious and unusual things and events, suitable for publication in its columns. When you run across something interesting kindly remember us.

ARCHITECTURAL DRAWING SELF-TAUGHT.

Carpenters, architects and other woodworkers who would like to learn drawing at home will find "Builders' Architectural Drawing Self-Taught," by Fred T. Hodgson, one of the most valuable works in print. This book, which has just been issued, tells all about drawing instruments and their accessories, with rules for using them and hints as to their care and management. Step by step the student is taught nearly all there is to know about drawing, from the simplest designs to the complete plans of a big modern building. The work contains more than 300 pages, printed on fine paper, and more than 300 illustrations explanatory of the lessons. The book is a course in drawing in itself. Price, $2. For sale by Popular Mechanics.

Popular Mechanics

Vol. 6. No. 5. CHICAGO, MAY, 1904. 10 Cents a copy. $1.00 a year.

Rockefeller Will Pipe Oil Across America

Gigantic Scheme to Cost Millions that will make the Standard Oil Company Independent of Railroads, and will Revolutionize the Methods of Transportation

Smoke that rolls from a thousand stacks and, commingling into one dense, massive cloud, is wafted out over the lake, enshrouding water and commerce in its gloom: rows of giant iron kettles, under which furnaces burn day and night; huge storage tanks dotting the ground as far as the eye can reach; sedulous, grimy streets as black as night, a city of perpetual exertion, a city of mystery whose happenings are rarely known and whose strictest law is secrecy. This is the colossal plant of the Standard Oil Company, at Whiting, Ind., the largest oil refinery in the world, which soon is to be made of three-fold more importance through a vast scheme of developing the new southern and western oil regions.

Above and below ground is a network of pipes of flowing oil, and the Whiting plant is the heart that pumps through these iron veins the life-blood of the Rockefeller millions. The plant is to be made the radiating point of the oil industry in America. From it pipe lines are to extend in all directions, tapping every oil region in the country.

Great City of Tanks and Smokestacks at the World's Largest Oil Refinery

Handling the entire crude oil production of the East, West and South, through underground pipe lines, instead of by railroad tank cars, is contemplated in the great development plan. Streams of oil flowing underground through connected pipe lines extending all the way from Port Arthur, Texas, through the oil regions of Oklahoma, Kansas, Indiana, Ohio and the East, to New York City, a distance of more than 2,500 miles, will be the result when the scheme materializes. From this great "trunk pipe line" branches will extend to all the Standard Oil refineries. This system of underground oil transportation will make the Standard Oil Company entirely independent of the railroads for handling crude oil. It will save the company millions of dollars annually in freight expenses and will annul the anti-rebate law so far as the Rockefeller interests are concerned, for Rockefeller will no longer have any cause for accepting rebates from railroads as none of them will be transporting his crude oils.

Scene in the Crude Oil Refinery Department

The Whiting plant is practically to become the central plant of a mammoth pumping system that will have streams of oil speeding underground across the continent, from the Gulf of Mexico to New York City. A visit to this great refinery, where tanks, stills, pipes, pumps and other machinery for building other refineries are now stacked up ready for shipment, is replete with interest. The plant is but 20 miles from Chicago, and though it is twice the size of the next largest oil refinery in the world—the one at Bayonne, N. J.—many people in Chicago scarcely know there is such a place in existence as Whiting, Ind. Few of the students of the University of Chicago, endowed by Rockefeller, know that over their very institution of learning rolls the smoke from a center of energy that is Rockefeller's greatest source of wealth. This is all because of the policy of secrecy that is early instilled into every person that derives his livelihood from the Standard Oil Company.

"The greatest offense an employe of the Whiting plant can commit is to talk," said an old resident of Whiting. This is certainly true, for, from no official, from the lowest paid ash carter to the vice-president, can any reliable information be obtained as to the extent or operation of the plant. No stranger is permitted to enter the works; few reports of accidents that occur here ever reach the outside world. Workmen are often carried from the shops dead and dying, but their closest friends and even their relatives may never know the cause.

The Standard Oil employes at Whiting are paid good salaries, they are treated well and may hold their positions through life by doing fair work if they will not talk, but talk they must not.

Disguised as a laborer of the Whiting plant, I, with some difficulty, succeeded in making my way through the great refinery and, with the aid of a hand camera, I took the first photographs of the Whiting plant that were ever obtained. Photographing any of the buildings or works here is

strictly prohibited. My camera was a box-shaped affair that could not be readily recognized as a picture-taking machine and was arranged so as to look more like a lunch basket. I walked straight forward without asking any questions, as though I were perfectly familiar with the establishments and the guards did not hinder me. My greatest trouble came when I wandered into a section of the plant that is malodorous with a nauseating gas that none but the inured can endure. Not knowing this I plodded on until a sickly feeling informed me that I must make my way out as speedily as possible. This I did, and with safety, but several times I thought the gas would overcome me before I could escape its terrible fumes.

This gas is said to have caused the death of a number of persons. It has a strange effect on the hair, beard and eyebrows of some of the workmen, sometimes giving to them a grassy hue. Whiting, Ind., may be said to be the only town in the world with citizens having green beards and hair.

The Whiting refinery was established in 1889, when two whole sections of land were purchased from Jacob Forsyth and Henry Scharge. It was from the beginning the Standard Company's largest plant and the world's largest refinery, and it has been added to and improved since then until its capacity is now more than doubled. At present there are more than 200 stills in which the crude oil is refined on the same principle that is employed in distilling whisky. The oil stills are immense kettles under which furnaces are kept burning. The vapor passes through coiled pipes cooled by water and is thus condensed into various oil products.

An eight-inch pipe line, reaching to the refinery from Lima, O., 200 miles, and fed by wells of the Ohio and Indiana fields en route, furnishes the present crude oil supply. There are pumping stations 50 miles apart all along this pipe line, and at each station there are about 10 men employed. The cost of transporting the oil through this pipe line is about one-tenth of what it would be if shipped by rail. The line pumps into Whiting each day an amount of oil averaging 300 cars, which is the present capacity of the plant. This

Rows of Stills as Far as the Eye Can Reach

capacity is to be greatly increased when the proposed improvements are made and when the great inter-state pipe line system is in operation.

The oil on reaching the plant through the pipe line is pumped into the immense storage tanks, of which there are 112 at the Whiting works. Each of these tanks holds 90,000 barrels of oil. The tanks are each 90 feet in diameter and 60 feet high. The oil which comes through the pipe line in excess of the consumption is stored in the tanks. The entire works, covering 1,200 acres, are connected with this 8-inch pipe line that supplies the plant. The connecting lines, of which there are a myriad, stretch in all directions above ground and under ground.

All the products that can be manufactured from crude oil are made at the Whiting plant. There is manufactured everything from naphtha and the finest illuminating oils to tar and paraffin wax, from which chewing gum and wax candles are made. It seems odd to think that chewing gum is made from kerosene oil, but even this has been accomplished through Rockefeller's exertions to convert oil into as many uses as possible.

The Whiting refinery, as well as being the center of the new pipe-line system, is the world's academy of the oil industry. Here are discovered all the new oil products; the new methods of handling and refining, and men are employed to do nothing else except devise new and improved ideas. M. W. Burton, superintendent of the plant, is one of the world's most famous expert oil chemists. He has under him a corps of experts whose sole duty is to experiment with the oil to see what can be done with it; what new products can be made from it; what new methods for handling it can be discovered. Painful and serious accidents have several times happened to the chemists, it is said, from the dangerous gases produced from the oils, but their work goes on uninterruptedly, year in and year out. The chemists have before them a miniature oil refinery containing every department of the big, real plant and experiments are made continuously with a view of improving each and every line of the work. It is due to these chemists' efforts that so many different kinds of products are now obtained from crude oil.

The first product of the still as the vapors condense are the lighter oils, such as naphtha, gasoline, etc. As the condensation proceeds on down the worm the heavier products result. They are such as ordinary kerosene, lubricating oils, fuel oils, etc. Each still is allowed to run about one week, when the fires are drawn and it is cleaned out. In the bottom of the still is a sediment that has formed, and this is called oil coke. It is the universal fuel of Whiting, Ind., little coal or wood being used by any of the residents of that city. The coke sells for $3.50 a ton. It is much lighter and goes much further than a ton of hard coal. It saved the people of Whiting and adjoining districts from suffering during the coal famine. Until a few years ago this sediment was used to fill sloughs and men were hired to haul it away.

Even after the pipe line is shut off there is a deadly gas that escapes from the stills after the fire is drawn, and numerous fatal accidents have resulted to men who have entered to remove the coke too early. Always, however, the men go down into the stills before they are cooled. They wear wooden shoes to prevent the heated sediment from burning their feet.

In making paraffin wax, one of the most important industries of the establishment, the crude oil is distilled into a dense, almost solid substance. The wax is perfectly white and not disagreeable to the taste. Tar manufacture is another important industry at the plant. There are numerous tar stills and the tar is produced by another method of distillation.

Besides the men whose duty it is to study out new products that can be obtained from oil, there is a corps of expert mechanics employed to devise means of economizing labor, of substituting machinery for hired help; and it is wonderful to note the success of their efforts. Everywhere about the plant there is the rush and roar of extreme energy and exertion, but the part the men play in the great manufactory is small. Improved machinery is doing the work; not that the employes are fewer than they ever were before, but the capacity of the plant is daily increased by new contrivances that make one man's efforts productive of greater results. In the entire Whiting plant, a veritable Colossus of modern industry, but 2,500 men are employed. The pay roll averages $140,000 a month. Shoveling coal requires the efforts of more men than any other single occupation, and it is a puzzle to the outside world to explain why the plant that handles more oil than any other plant in existence should itself burn

coal instead of fuel oil. It takes 700 men to lift the coal shovel that fires the Whiting plant, which burns 200 car loads of coal a day.

The Whiting plant is under the direct supervision of W. P. Cowan, first vice-president of the Standard Oil Company, whose office is at the western headquarters of the company, 5 Randolph street, Chicago. It is Mr. Cowan who is at the head of all the vast improvements the company now has in contemplation in the West.

Streets of Grime as Black as Night

Outside of the packing houses there is probably no industry subsidiary to Chicago of half such consequence as the oil refinery at Whiting. The value of the plant, as estimated by city officials, and real estate men of Whiting and other parts of Indiana, is $35,000,000. The company pays taxes on $3,000,000 of property. The plant is the only source of revenue of the town of Whiting, which has a population of 6,000. The Whiting plant is dotted with enormous smokestacks, and an idea of the value of the establishment might be obtained when it is stated that these smokestacks cost $5,000 each to erect. The stacks reach 100 feet in air and from them rolls the smoke which from the lake gives the plant the appearance of a dense, black cloud enshrouding the water.

While the Whiting plant is at present fed from the Ohio and Indiana fields, it is believed that this arrangement is to be changed and that the new Kansas oil fields are soon to supply this greatest of the world's refineries. In that event the Ohio and Indiana oil will be used to supply the eastern refineries, and the Kansas City refinery, that is soon to be built, at present to refine Kansas oil, will in time obtain its crude oil supply through pipe lines tapping the Oklahoma and Indian territory fields and possibly the Texas fields.

The anti-rebate law is indirectly responsible for the establishment of the mammoth pipe line system that threatens in time to reach from ocean to ocean across the United States. The law was aimed at the Standard Oil practices which so effectively restricted competition a few years ago.

Since 1902 the United States has led the world in the production of petroleum and the output is still increasing by the constant opening up of new fields. Russia, the nearest competitor to the United States, in its last report shows a decline. In 1902 the United States produced 48 per cent of the

entire petroleum output of the world and the figures doubtless will be greatly increased when the report of 1903 is issued. In 1902 the United States produced 88,377,722 barrels, which was 8,266,862 barrels more than Russia and 19,377,722 barrels more than the preceding year's production of the United States. Russia's production showed a decline of 4,628,512 from the preceding year.

For this increase the United States is indebted to the West and South. But for them the output would have fallen far below that of Russia and in fact would have shown a decrease compared with the production of 1901. All the old eastern oil fields which have heretofore been the principal source of the Rockefeller millions and of the big American oil production show a falling off. The great Appalachian field, whose supply was once declared inexhaustible, fell off 2,599,384 barrels, or 4.76 per cent. This, too, after there had been sunk in this field 1,562 more wells than were opened in the previous year, in a desperate but vain effort to retain its regular output.

Pennsylvania showed a decrease of 4.45 per cent; New York of 7.20 per cent; Ohio, 2.93 per cent; West Virginia, 4.68 per cent, and Illinois, 20 per cent. Texas showed an increase of 311 per cent; California, 59 per cent; Kansas, 85 per cent; Indiana, 30 per cent; Indian Territory, 270 per cent, and Kentucky and Tennessee, 35 per cent.

These figures tell volumes. They would indicate that the United States is destined to supply the world with oil and that the supply must come from the West and South. The eastern United States fields and the Russian fields are falling off and the western and southern United States fields are increasing in enormous proportions. Besides this, new western and southern fields are being constantly discovered. Alaska is regarded as an important field for prospecting at present.

The Standard Oil Company, therefore, has recognized the coming great importance of the new oil fields as the future source of supply and has taken steps toward their development to a high degree. For this purpose the vast improvements are to be made at a cost of probably $200,000,000. The immediate improvements, besides the numerous pipe line constructions, include the erection of a big refinery at Kansas City, the employment of a fleet of oil steamers on the Great Lakes, and the construction of ports specially for the docking of the oil steamers. Five of these oil steamers are already built and will be placed in commission this season. A pipe line will at once be built to carry oil from Neodesha, Kan., where there is a small refinery now located. Pipe lines already branch out to different sections of the Kansas fields. The Kansas City plant will contain 30 stills for refining oil and there will be an acid plant, paraffin works, candle works, and facilities for the manufacture of all kinds of illuminating and lubricating oils, gasoline, axle grease, tar, etc. The plant will comprise 120 acres.

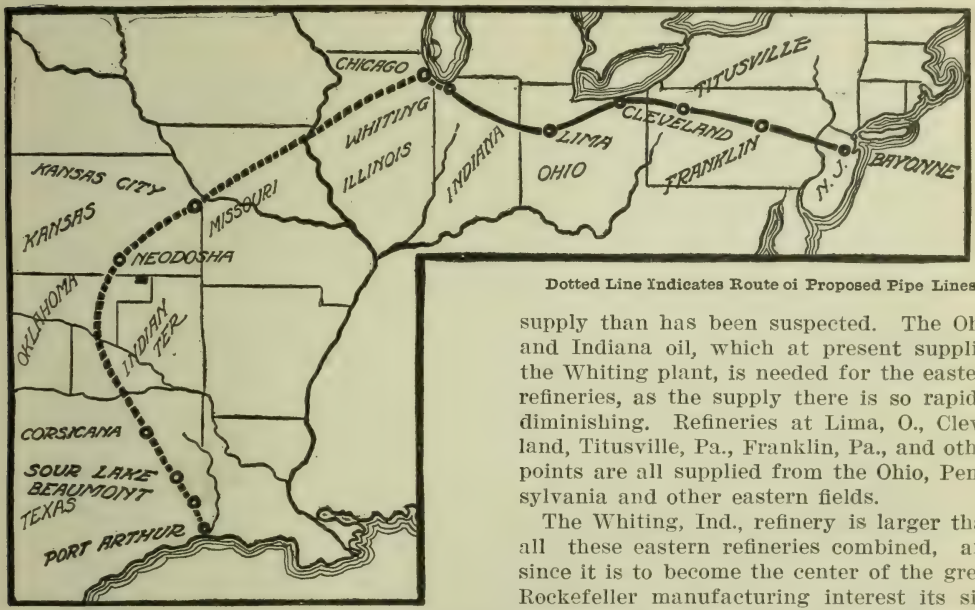
Distilling Kettles as Seen From a Distance

A pipe line is planned to run from Whiting to Neodesha, Kan., which will then give a continuous line from Kansas City to Chicago and thence to Lima, O. By this time pipe lines will have been built east from Lima to Bayonne, N. J., where the second largest refinery in America is located. Bayonne is just across the bay from New York and is connected by pipe lines with all the great eastern oil fields. The next step in the gigantic plan will be the building of a pipe line from the Beaumont oil fields to Kansas City. This will complete the chain of pipe lines from the Gulf of Mexico to the Atlantic ocean and from them branches will extend to every oil district in the South, West and East.

The mammoth scheme of developing the Kansas oil fields, shows that the Standard company expects more from that source of supply than has been suspected. The Ohio and Indiana oil, which at present supplies the Whiting plant, is needed for the eastern refineries, as the supply there is so rapidly diminishing. Refineries at Lima, O., Cleveland, Titusville, Pa., Franklin, Pa., and other points are all supplied from the Ohio, Pennsylvania and other eastern fields.

The Whiting, Ind., refinery is larger than all these eastern refineries combined, and since it is to become the center of the great Rockefeller manufacturing interest its size and importance will be greatly increased. The Whiting plant is to become what might be termed the capital of the oil world.

Map Showing Proposed Pipe Lines and Those Already Built.

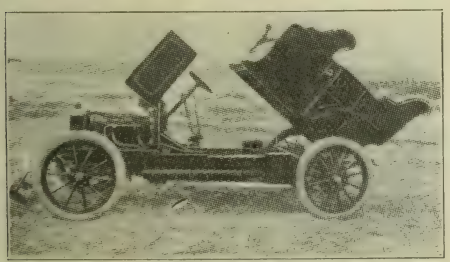


Dotted Line Indicates Route oi Proposed Pipe Lines

CONVENIENTLY BUILT AUTOMOBILE.

New Paris Type Has a Body That Can be Tipped Up For Repairs

An oddly built automobile, which has made its appearance in Paris, may suggest a new method of constructing these vehicles. The machine is known as the Martini type and is so built that its body can be lifted up to give easy access to all parts of the machinery for speedy repairs. This should prove a great convenience in case of accident on the road. The car illustrated is the one in which Capt. H. H. P. Deasy drove up the mountain railway to the summit of the Rochers de Naye. It has 20 horsepower and is of the same type as the vehicle that won the gold medal in the European 1000-mile reliability trials. It is placed on a section of the cog-wheel track set at an angle equivalent to the average gradient that had to be negotiated. The drive on the top speed of the four forward ones is direct. Ball bearings are employed throughout the mechanism.



Martini-Built Automobile with Body Tipped

"Water Curtain," a Perfect Theatre Protection

It Completely Covers the Proscenium Arch With a Liquid Wall

Solid sheets of water rising from the footlights and stretching across the proscenium arch, forming a wall of water completely separating the stage from the auditorium—this may be the fire curtain of the future. The "water curtain," which will doubtless be installed in all first-class play houses of the future, is the invention of John W. Regan, late chief of the Boston fire department, and is called the "Regan."

A pipe leads from a main in the street underneath the stage to the centre of the proscenium arch. The nozzle is screwed on to it flush with the top of the stage floor. If there is not pressure enough from the street, which should be at least 60 lbs., it must be supplied from a tank from above.

This will give three sheets of water 150 feet wide and 60 feet high. Of course there is the double action of the water going up and coming down. One of these curtains will protect the Boston theatre stage which is the largest stage in the world. The water curtain will also lift the smoke so that the auditorium will be clear and the audience can walk right out. Such a curtain might have prevented the Iroquois disaster.

The curtain of water is produced by a peculiarly shaped nozzle attached to a piece of pipe with an elbow extending upward. Across the nozzle are three slots, each about a quarter of an inch wide and extending from side to side. The top of the nozzle is not unlike a two-wick burner of a kerosene lamp. The nozzle, however, has three slots and from them water radiates in three separate sheets making a water curtain three layers thick forming a barrier absolutely impervious to flame.

Water Curtain Three Layers Thick and 100 Feet Wide as Tested on the Streets of Boston

The illustration shows the "water curtain" in a test exhibition on the streets of Boston. It will be noticed that the water flares out like a great fan, 50 feet high and 100 feet wide. Not only for theatre curtains, but for the interior and exterior of buildings is the invention designed.

Terrible Tragedy of the Submarine "A1."

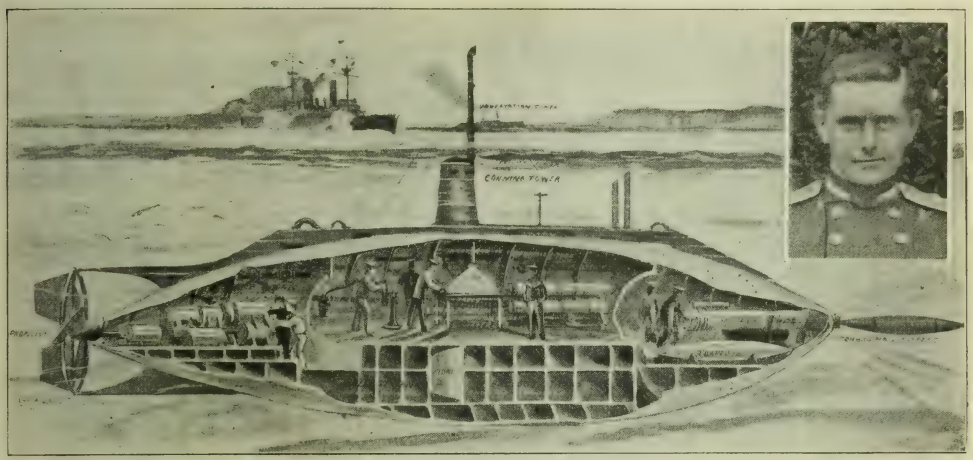
A True Story of the Loss of a Gallant Craft and Crew at the Recent Maneuvers in England

England has furnished to the navies of the world this terrible lesson on the necessity of improved periscopes enabling submarines to better see their way under water:

CHAPTER I.

Of the 29 submarine torpedo boats possessed by the British government, the "A1" as her name might imply, was the pride of that fleet of little under-water maneuverers. She was manned by the pride crew of British sub-aquatic navigators and all England was proud of her. There was a week of maneuvers at Portsmouth participated in by many splendid vessels of many kinds and witnessed by England's royalty. The "A1" was the most picturesque figure of these maneuvers. To show his appreciation of the agile little submarine and her daring crew his Royal Highness, the Prince of Wales, boarded her in person and complimented the commander. As handsome as he was daring was Lieutenant Mansergh, who commanded the "A1". He was assisted by Sub-Lieutenant John Churchill of noble British descent, and by a crew of nine petty officers and seamen as brave as ever rode with a boat above or beneath the waves.

The "A1" was the latest and most powerful of the British submarines. When submerged she displaced 180 tons. She was 100 feet long and 10 feet diameter with a tall conning tower plated with 4-inch steel, and a platform deck for the use of the crew when running awash. She was propelled by one screw, which was driven by a gasoline engine when running on the surface. In this trim she is reported to have made 15 knots an hour, which would make her the fastest submarine in the world. Under water she used an electric motor, supplied with current from storage batteries and capable of taking her 32 miles at the rate of eight knots. The hull of the boat was of steel from one-half to a quarter of an inch thick, supported by strong framing and further stiffened by bulkheads, which divided her into compartments. She had one torpedo tube in her bow, differing in this from all other subsequent submarines, which have two tubes. She carried 850 gallons of gasoline and a large quantity of air compressed in steel flasks under a pressure of 2,000 pounds to the square inch. She dived porpoise-fashion; that is, she did not sink by admitting water ballast, but by setting her horizontal rudder downwards, when her movement in the water made her take a "header." Of course, as a preliminary her trim was adjusted so as to offer very little resistance or buoyancy. To regain the surface she set her horizontal rudders upwards or in an



Sectional View Showing Interior of the "A1."--The Upper Right-Hand Corner Cut is of Her Gallant Commander Lieutenant Mansergh

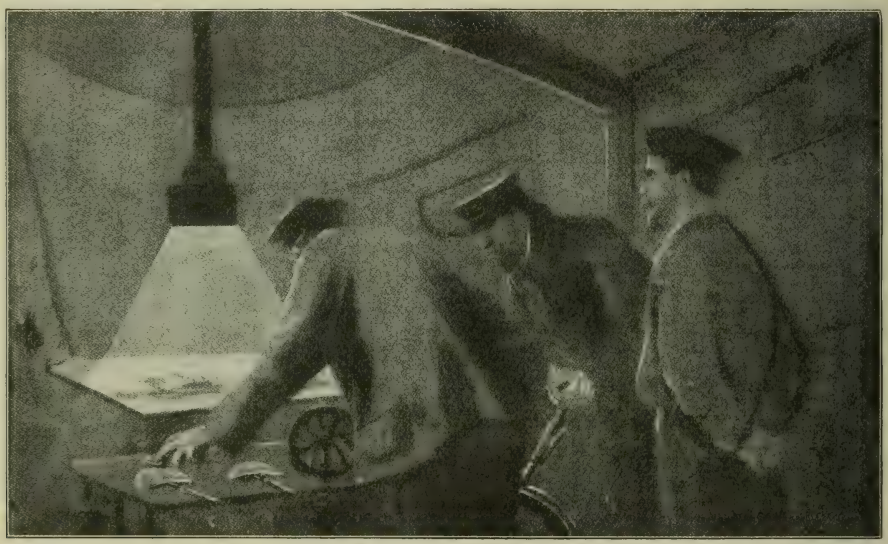
emergency could expel water ballast from her ballast tanks. With this equipment the "A1" excelled all her rivals in quick movements and her wondrous work won applause at every turn.

CHAPTER II.

It was the last day of the week's maneuvers, at Portsmouth—Friday, March 18—and every day the "A1" had distinguished herself. In the afternoon all the submarines were close in shore giving many and varied demonstrations of their prowess. The "A1" was seen to submerge herself and her periscope was seen protruding above the surface of the sea. The "Berwick Castle" a passenger liner on her way from Southampton to Hamburg passed in their midst while the little boats were darting in and out of the water. The Berwick Castle called out through megaphone to the umpire's yacht, "Fire Queen," that she had been struck by something. Little attention was paid to this, however, and the manuevers went on. Two hours later the time for the closing of the day's program arrived and the signal was given for the submarines to return to Spithead. Two of the submarines, including the "A1", failed to appear at the appointed time. An hour passed and one of the missing vessels arrived, but it was not the "A1". Another hour and still England's finest submarine was missing. Glasses scanned the water and searchers were sent out but no tidings of the boat were obtained.

CHAPTER III.

Elated over her achievements and the high compliment that had been paid her by the Prince of Wales, a couple of days before, the gallant crew of the "A1" had decided to close the week's maneuvers with another brilliant feat. She submerged herself off the Nab Lightship and waited for the "bully" of the attacking cruisers to pass when she intended to torpedo the vessel that had successfully defied so many attempts before. As she was waiting the great passenger liner, the "Berwick Castle", came up at high speed from a different quarter.



Steering The Submarine by Means of the Periscope

The day was dark and hazy and because of the imperfect view afforded by the best periscopes, the officers were unable to see the approaching ship. The great liner passed directly over the little submarine tearing off the top of her conning tower. There was a moment of awful consternation as the water came rushing in from above on the officers and crew. There was no escape. The curved iron walls of the vessel hemmed them in on every side. A sea of water was overhead; the ocean's bed below. No air—only water; it strangled them. The boat was filled, and in their struggles with death they felt the gallant "A1" diving deeper than she had ever dived

Watching the Monometers While Running Submerged

before. She was going to the bottom. On down she went and settled on the floor of the sea forming a sepulchre for the remains of the gallant officers and crew—like an ocean's magic coffin, which in punishment of the men who had dared stray beyond the natural elements of man, had entombed them alive and borne them dying and dead to the ocean's graveyard.

CHAPTER IV.

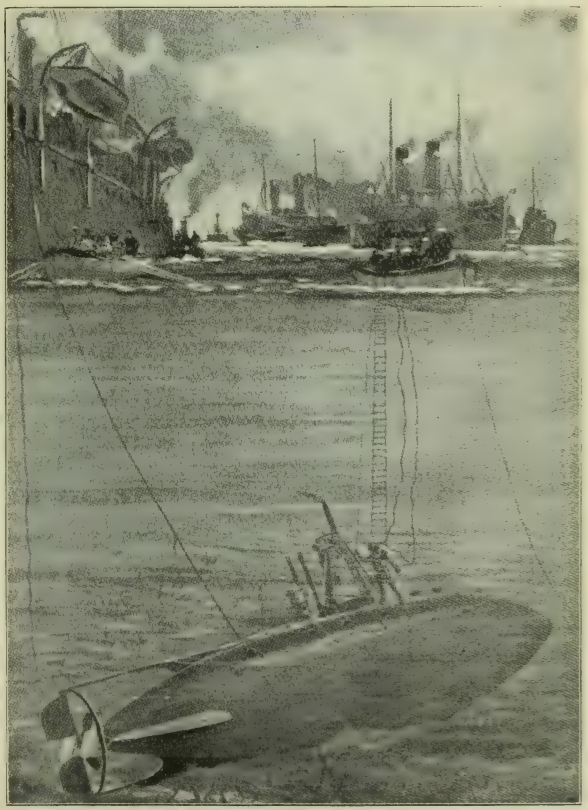
Saturday morning came and all at Portsmouth harbor were in anxiety over the missing submarine. Some one recalled the fact that the liner "Berwick Castle," had signalled the umpire's yacht on the day before that she had been struck by something. All then said that this must have caused the sinking of the "A1." Divers were sent down and sure enough there lay the submarine with all her officers and crew but one man dead inside.

Then began the work of clearing the vessel of water by pumping in compressed air. That same day the following telegram was received from the Prince of Wales:

"The Princess and I are deeply shocked to hear of the terrible disaster to Submarine 'A1' and the loss of her whole crew. We grieve to think of the relatives of those who are gone, and we feel deeply for you in this sad catastrophe.—George."

THE LESSON.

Even when the conning tower of a submarine is above water, the periscope affords the only means its occupants have of determining what is happening on the surface of the water above. This periscope, as at present constructed, does not cover the whole horizon, but only a small section of it, so that if the officer in charge was intently watching one quarter of the horizon, a ship might come up quickly from another quarter without his ever seeing it. Probably the officer in charge of the "A1" saw nothing whatever of the "Berwick Castle," or if he did see her, it was too late. An improved periscope, enabling a wide range of vision, would have prevented the awful disaster to the "A1." The improvement must be made before the submarine can be called a success.



Fishing the "A1" From the Bottom of the Sea, Showing the Exact Position in which the Boat was Found.--The Size of the Submarine is Exaggerated in Order to Secure a Pictorial Quality.

Popular Mechanics
A MONTHLY MAGAZINE
"Written so You Can Understand It"
PUBLISHED BY POPULAR MECHANICS CO.
Journal Building Chicago, Illinois

SUBSCRIPTION
United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00
Foreign Countries, post paid, - - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address
POPULAR MECHANICS
JOURNAL BUILDING, : : : CHICAGO

LONG DISTANCE TELEPHONE MAIN 2682

Entered at Chicago Postoffice as mail matter of the Second Class

HOW THE ADMIRAL CONTROLS THE SHIP.

The modern admiral controls the whole working of his ship from the small bomb-proof chamber known as the conning-tower. He has the steersman at his elbow and on the right and left of the wheel stand the "telegraphs" which communicate to the engine room the orders: "Full steam ahead," "Full steam astern," "Half steam ahead, or astern," "Dead slow," "Stand by," and "Stop." There is communication by speaking tubes and electric bells with every part of the ship, and each gun may be said to be practically fired by the admiral. The positions of Admiral Togo and his officers, shown in the illustration, are from a Japanese picture, but the details of the arrangement of the conning tower were supplied by a naval expert.

Admiral Togo on His Flag Ship

"DANGER SIGNALS" FOR SUBMARINES.

The terrible disaster to the Submarine "A1" as described elsewhere in this issue, besides showing the need of an improved periscope, shows the necessity of some method of giving a distress signal when a submarine has met with accident. The "A1" went down while battleships and boats of all kinds were all around her. Evidence indicates that a man of the "A1's" crew had been fired out of a torpedo tube while she was sinking, in the hope that he would be able to reach the surface of the water and give the signal that the others had gone to the bottom. The body of the man, believed to have been fired from the torpedo tube, was not found in the boat with the other members of the crew. Of course this method of signaling, used as a last resort, failed absolutely.

Torpedo boats should be provided with some kind of float attached to the boat which could be cut loose in an emergency and which would at once rise to the top and there, coming in contact with the air, explode and emit a light as a distress signal. Some contrivance like a "Holmes light" would doubtless answer the purpose. This light is used in running torpedoes for exercise and might well be adapted to torpedo boats. The light consists of an arrow-headed tin canister pierced with several holes and filled with phosphide of calcium. The action of water on the chemical causes a rush of bubbles to fly to the surface of the water, where, on mixing with the oxygen of the air, they burst into flame and give out an enormous amount of garlic-smelling smoke.

At present the man who goes down in a torpedo boat takes his life in his own hands.

The Great Trans-Siberian Railroad

The World's Longest Line of 5,400 Miles Built by Russia at a Cost of $200,000,000

Stretching 5,400 miles from Moscow to Port Arthur, the Trans-Siberian railroad connects the heart of Russia with its far eastern possessions and is the longest, costliest and most remarkable railroad ever built. In the 5,400 miles of its distance from Moscow to Port Arthur, there are 100 miles of bridges, some of which span streams more than a mile wide and are imbedded in treacherous, shifting sands.

At Harbin, in Manchuria, the road divides, one line extending east to Vladivostock and the other south to Port Arthur. The longest run is from Moscow to Port Arthur. That part of the road in Chinese territory, about 1,600 miles, is called the Chinese Eastern railway. What is known as the Trans-Siberian railroad, proper, extends from Moscow to Irkutsk, Siberia, which is 43 miles west of Lake Baikal, and is 3,672 miles from Moscow.

The Chinese Eastern railway is but another name for that part of the Trans-Siberian railway east of Lake Baikal, just as the Texas line of the Rock Island road is called the Chicago, Rock Island and Texas, instead of the Chicago, Rock Island and Pacific. The concession for the construction of this section was granted by China in return for Russian diplomatic and financial help in settling the issues arising out of the war between China and Japan. From Nikolskoe, near Vladivostock, a branch line called the Ussuri railway extends north 375 miles to Khabaroosk, on the Amur river.

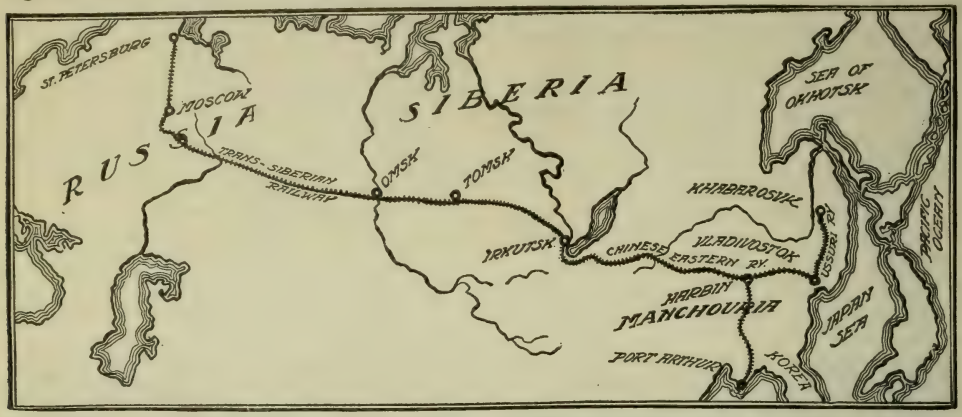
Like all the Russian railways, the Trans-Siberian was built and is operated by the Russian government. The first tie was laid at the Pacific terminal of Vladivostock, May 12, 1891, by the present Czar, Nicholas II., who was then Czarowitz.

Military Trains Crossing Lake Baikal on Rails Laid on the Ice

Preliminary work on the line began early in the 70's. The great bridge over the Volga was completed in 1880.

Noted throughout Russia are the famous trains de luxe, which leave Moscow once a week. This is the finest and fastest train on the Trans-Siberian road. It makes its run to Valdivostock in 18 days. At Harbin the through cars for Port Arthur are cut off and reach their destination two days later. Port Arthur is 210 miles further from Harbin. To show the superiority of American traffic, it should be remembered that the run from

New York to San Francisco, 3,250 miles, is accomplished in four days and ten hours. Slower passenger trains on the Trans-Siberian require a month to make the trip, and freight trains two months. All the railroads of Russia, of which there are 25,000 miles, have a 5-foot gauge, which being different from that of any other country, makes it impossible for any alien rolling stock to be used on this or any other line of the Czar's domain. The standard gauge of all other continental railroads is 4 feet 8½ inches.



Map Showing the Route and Three Different Divisions of The Trans-Siberian Railway

More than $200,000,000 was required to build the road and the cost will be increased by $20,000,000 when the line around Lake Baikal is completed. Lake Baikal is the mysterious Holy Sea of Siberia and furnishes the only break in the entire distance of the line from Moscow to the Pacific coast. This is the only body of fresh water in the world that is inhabited by seals. It is the deepest body of fresh water in the world, reaching the enormous depth of 5,000 feet. The lake's level is 1,500 feet above the sea level, while its bottom is 3,800 feet below the sea level. Lofty mountains wall it in on every side and the rocky shores are seamed by innumerable torrents that have to be bridged. The lake has an area of nearly 15,000 square miles. It is 500 miles long and is 42 miles wide at the point where it is crossed by the Trans-Siberian railroad ferry. An ice-breaking ferry boat, the largest in the world, built at a cost of $4,500,000, is operated across the lake in winter.

Russian Military Railway Across An Ice-Bound River

Henry C. Rouse, president of the Missouri, Kansas & Texas railroad, who made a trip over the Trans-Siberian a short time ago, says:

"The Trans-Siberian road is today in about the same condition for actual service as was the Northern Pacific railroad a few years before I became receiver of it. It was built by methods akin to those by which our great transcontinental roads were built.

"The bridges, with the exception of those on the old road in level country west of Samara, are up to the requirement of the modern American motive power. Some of the track now in use on the greater part of the Trans-Siberian line, especially on the east end, is still laid with 56-pound rail, which is rapidly being relaid with 65-pound rail. Much of the track is still unballasted and

some of it is not even properly surfaced in Manchuria, where, however, the ties are the worst feature of the work, few and far between, and many of them round on top, having not more than a 4-inch face, being made by splitting a pine log in two, laying the flat face to the ground and adzing off the spot to receive the rail on the round side.

"To all appearances the road is well located with good alignment and slight curvature and modern grades, save on the Ural mountain division, where the trains reach an altitude of 3,600 feet, about half that attained by the trains on crossing the Great Divide of the United States. Sidings have been built at intervals of 12 or 15 miles along the line.

"Much has been said of the Trans-Siberian railway's inefficiency on account of its being a single-track line, but the fact is seemingly overlooked in this criticism of the Trans-Siberian system that the great trunk lines of America are mostly single track west of Pittsburg and that barely seven per cent of all the main line mileage in the United States is double tracked.

"The efficiency of the entire Trans-Siberian road depends on its efficiency to transport passengers and merchandise across Lake Baikal.

"The railway now being built around the lake involves much more tunneling and other heavy work. Such a lake shore line will do much toward bringing the road up to the efficiency of some of our own transcontinental systems."

The Trans-Siberian road connects the Ural frontier with the lines of European Russia and now affords unbroken railway communication between the Pacific coast and the capitals of Europe. The road was built entirely by Russian engineers, though many of the rails and some of the rolling stock came from the United States. The rapidity of construction of the Canadian Pacific railway, averaging 300 miles annually for 10 years, is often cited as marvelous; but of this Russian line 5,166 miles were built in 10½ years, or at the rate of nearly 500 miles a year. Moreover, a change of plan to secure a firmer roadbed and safer and more adequate service necessitated reconstruction after a considerable portion of the line had been completed.

When the section around Lake Baikal is finished, the time of passage from St. Petersburg to Port Arthur or Vladivostock will be reduced to about 12 days.

Train Approaching Lake Baikal

The railway stations along the Trans-Siberian are, as a rule, superior to those of the rural districts of the United States. No two of them are exactly alike in style. At every station the government has built a church; even at the smallest depots, where the place of worship is 10 by 12 feet.

Bridges along the route are built of steel and substantial masonry and their construction is especially commendable. The bridge over the Irtish at Omsk is one of the finest in the world. With its approaches it is nearly four miles long and has an opening of 2,100 feet. A bridge 3,000 feet long spans the Yenisei, the grandest river of Siberia. The Amur river at Khabarovka is crossed by a bridge nearly 5,100 feet long. Forty-six bridges, none less than 200 feet long, cross tributaries of the Obi river between

Immigrant Car on the Trans-Siberian

Fourth Class Cars on the Trans-Siberian Railway

Irkutsk and Lake Baikal, a distance of only 41 miles.

For 600 miles the western section of the road runs through a splendid farming country, producing an abundance of grains of all kinds; 300 miles is through a well-watered grazing district, and for 200 miles east of the Obi the surface of the country, though broken by hills, is heavily-timbered and well-drained. The central division, between Tomsk and Irkutsk, traverses on the whole a barren upland of unknown mineral possibilities, but whose climate and soil forbid settlement. East of Lake Baikal the road rises gradually to the crest of the Yablonoi mountains, there reaching its highest elevation, 3,412 feet, and thence descending the Pacific slope to the valley of the Amur.

Alfred S. Johnson, Ph. D., says: "This trans-Baikalian section traverses one of the wildest and most romantic tracts ever penetrated by railroad engineers, a section of untold wealth in gold, silver, copper and iron, which is already attracting a rapidly growing population. The Amur division, as projected, has its route for about 1,600 miles through a well-timbered alluvial land, enjoying a climate tempered by proximity to the Pacific; while the Ussuri section, extending up the valley of the river of that name, from its junction with the Amur at the point where the latter turns abruptly northward on its final rush to the sea, runs through a hilly country, well adapted to agriculture and stock-raising and rich in bituminous coal."

Both the branches through Manchuria tap a rich and thickly settled farming country.

The road crosses the four great rivers, the Obi, Yenisei, Lena and Amur, over their upper waters at about the point where they begin to be easily navigable, thus facilitating communication throughout the entire length of their valleys. This is of special importance in aiding the movement of cereals, which comprise one-half the total exports of Siberia. The annual grain crop amounts to about 4,000,000 tons.

The Technical World says: "The facilities of communication offered by the road will also stimulate development of the arable plains and the cattle-breeding districts of the Steppes now roamed by the Kirgiz race, the finest of the Tartars. For Siberia has the largest grazing reaches in the world and is the original home of the whole granivorous stock."

Last year the Trans-Siberian road carried 1,000,000 tons of freight and in all 1,300,000 passengers. The locomotives, while in good operating condition, are for the most part wood-burning and of the type in common use in this country during the '80's. Passenger accommodations are divided into first, second, third or fourth class. A fourth-class car will accommodate 12 cattle or 40 persons, and is used interchangeably.

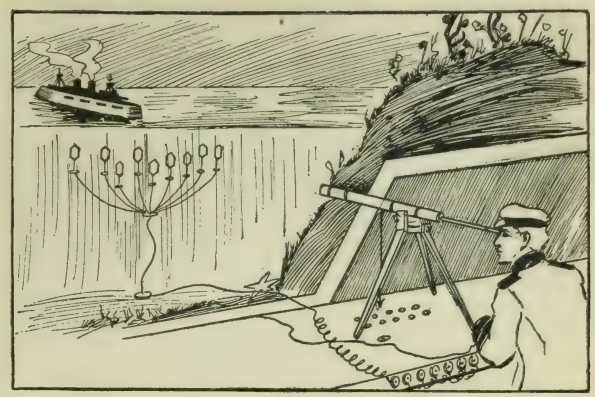
Flat Cars Carry War Vehicles

Popular Mechanics is the first mechanical publication in the world to publish records and descriptions of mechanical events and constructions so that anyone, whether he be a mechanical student or not, can comprehend their meaning. There are innumerable mechanical journals published, but just one "written so you can understand it." To demonstrate the demand for such a publication you have but to read the first line on the front cover of Popular Mechanics which says: "Largest Circulation of any Mechanical Publication in the World."

Under-Water Terrors of Modern Warfare

Submarine Mine the Most Dreaded of All Death-Dealing Devices--How They Are Constructed and Operated

Seated in his little underground room beneath a clump of bushes the operator of submarine mines, himself secure from danger, looks out through a peep-hole and watches the enemy's ships approach the harbor; he scans his diagram of the water; he notes the position of the ships and, sure of the location, he begins to press the buttons on the table before him. Every time he presses a button a ship is probably tossed up in a great wall of water and blown to destruction.



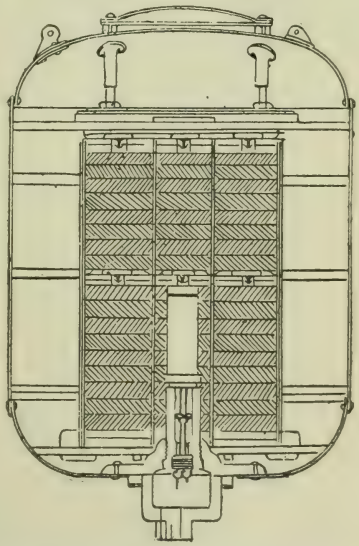
Operator Manipulating Observation Mines From His Underground Room

The diagram before the operator indicates the location of hidden submarine mines guarding the harbor. Each line of mines is connected by electric wires with the table before the operator. The mere pressing of a key discharges a line of probably six mines and it is the operator's duty to discharge a line of mines every time a ship chances to be within the mine's destructive range.

The operator's underground room or cave is on shore overlooking the harbor. It is so located that the occupant can have a clear view of the mine field without being seen himself. The cave is just large enough to permit him to be seated comfortably and to have easy access to his firing battery and key. If possible, the observation station is hidden with bushes, vines or other vegetation that will not attract the enemy's attention. If in barren ground the peep hole is made very small and any wood about the construction is painted as near as possible the color of the surrounding soil.

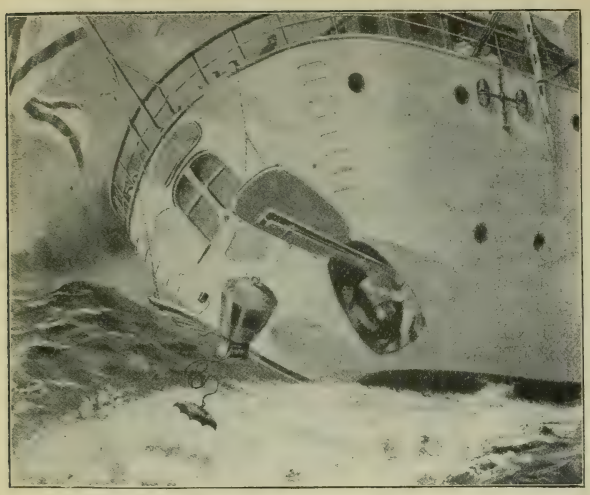
This particular kind of mine that is discharged by the operator is known as the "observation mine," so called because it is worked by the observations from shore. There are other kinds of mines that are not discharged until they are actually touched by the bottom of the ship. These are known as "electro-contact mines" and "electro-mechanical mines."

Submarine mines are very dangerous things to handle and, unless the utmost caution is exercised, they may be of more destruction to the ships of the country they are supposed to protect than to the enemy. Such has been the case at Port Arthur and Dalny where several of the Russian vessels are said to have met destruction by mines the Russians had planted to guard the harbors. The Russian mine-transport "Yenesei" was employed especially to lay mines. The mines used by the Russians are known as



Showing Construction of an Observation Mine

"Malinorowski" mines and are the same as the American and English "electro-mechanical" mines, which are self-operating. One of the illustrations shows the ill-fated vessel



Russian Transport "Yenesei" Laying Mines

engaged in the work of laying the mines. The method was as follows: When the port was opened a spar shaped like a T-girder was made to project from it. Along the narrower part of the spar ran a sliding hook to which the mine was attached and drawn out until it overhung the water. At the proper moment a cord was pulled which released the mine and let it fall into the water. The mine then moored itself automatically, as shown in the illustration on the opposite page. When the case M, containing the charge had sunk to a certain depth, it received some support from the float b, and thereupon the anchor A began to unwind itself from the drum D until it found its hold in the sea-floor. The mine would keep a uniform depth below the surface and would rise and fall with the tide. The moment a passing ship struck any of the passing studs t t t the mine would explode. One of the mines thus laid by the "Yenesei" at Dalny was struck by that vessel and the "Yenesei" was destroyed.

Mines, like many other of war's deadliest devices, had their birth during the struggle between the north and south in the American War of the Rebellion.

The Royal Navy Handbook of England says: "Both torpedoes and mines came into existence during the progress of the American War of Secession, when no fewer than 28 vessels were blown up by mines and six vessels by various forms of torpedoes. Their remarkable success set a good many clever heads thinking and it was in 1864, only two years later, that the original idea of the torpedo was evolved from the brain of an officer of the Austrian army."

In those days, however, the use of electricity was little understood, or that great force, which also owes its adaptation to America, would have rendered the mines a hundred times more deadly. The explosives then were also comparatively inferior. Commander Charles Napier Robinson of the British Royal Navy in a work on submarine mines, says: "In the American War of Secession, when so many vessels were sent to the bottom by torpedoes, the mines were more often than not of the most makeshift description. Wooden barrels made water-tight filled with gunpowder, and fired by hauling-lines or slow-burning fuses, were the usual instruments whereby the Confederates conducted their subaqueous attacks on their opponents; for electricity and its application to submarine warfare was then only very imperfectly understood. Yet nearly 30 vessels were sunk by these means, thereby clearly proving that mines have not necessarily to be of delicate construction to be efficient. On the other hand it may perhaps be taken for granted that, for every mine which accomplished the work for which it was intended, dozens of others failed ignominiously, as for instance in the case when Admiral Farragut brought his fleet safely over the mine-field which should, if it had been in an efficient condition, have utterly destroyed him. Yet even at the present time our seamen are taught how to carefully prepare extemporé mines from the crudest materials and there is little doubt that, provided proper care and intelligence are displayed in their preparation, they will prove nearly as effective and reliable as the modern up-to-date submarine weapon."

Admiral Farragut's achievement, alluded to by the English writer, was at Mobile, where the harbor was known to be alive with mines. The admiral was warned against entering. Already one of his ships, the "Tecumseh," had been sunk by one of the hidden explosives and the admiral again was told to turn back and beware of the mines. "Damn the mines," said Admiral Farragut and he steered the whole fleet into the harbor. The cases of the torpedoes were heard by many on board knocking against the copper sheeting of the bottom and many of the primers snapped audibly,

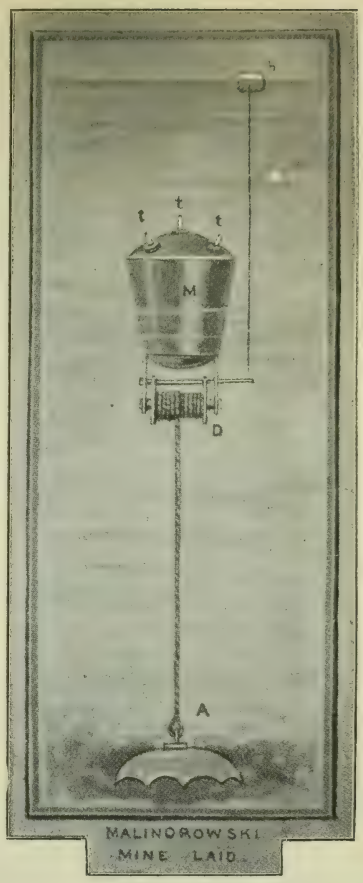
but no torpedo exploded. It happened that the mines were all defective, otherwise the admiral's fleet would have met certain destruction. He knew this, but his fleet was in a state of utter confusion and to recede was as dangerous as facing the mines. Victory rewarded his daring.

"Although the admiral successfully defied the mine field," says an English writer, "probably no man has ever lived who has so thoroughly experienced the moral power of one."

Mines are dreaded far more than guns by an attacking fleet. It was the mines at Port Arthur that kept the Japanese from capturing that city when it was otherwise almost defenseless. An opposing fleet might easily bring itself to attack a flotilla of torpedo vessels, but it would hesitate very considerably before risking its vitals over a mine field.

One of the best evidences of the moral power of the mines is furnished in an instance of the Franco-Prussian war when the French fleet was prevented from entering Prussian harbors simply through fear of submarine dangers.

An explosive more deadly than dynamite, nitro-glycerine or guncotton is now used in the mines manufactured to defend American harbors. The explosive is called "maxemite." Loaded with it the explosion of a 72-pound mine is certain destruction to any ship that floats. These are for emergency use, however, and the usual form of observation mine manufactured in the United States and Great Britain is loaded with 500 pounds of guncotton. The observation mine consists of a cylindrical case of steel plate 3/16-inch thick, 32.2 inches in diameter, and 34 inches deep with its ends rounded. Eyebolts are riveted on the top and bottom for handling and anchoring. Access to the inside of the mine is given from both ends. The mine charge is packed in 22 copper cases stowed in two tiers, each case being fitted with rewetting holes; the center copper case has a hole in it for the reception of a primer tip, which is used for the purpose of exploding the wet guncotton and consists of a tin filled with disks of dry guncotton with detonators fitted into them. The wires leading into the mine pass through what is called an "insulating plug" fitted in the mouthpiece of the mine. This plug is kept ready-fitted for insertion into the mouthpiece of the mine and has two 3-foot wires rove through it, the nut being placed at a distance



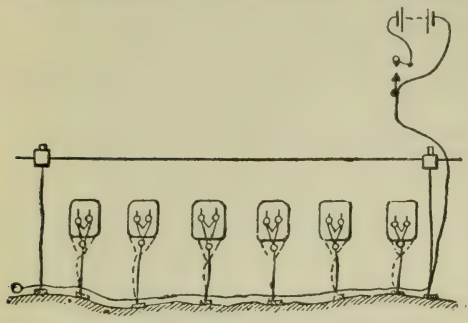
Automatically-Moored Mine

of eight inches from one end of them. By means of "puddings" on the wires, gland nuts and leather washers, the insulating plug is kept absolutely watertight in the mouthpiece. The insulating plug is a most important part of the mine's construction and is, therefore, always carefully tested.

In fitting the mine for service, the dome, insulating plug and mouthpiece are removed, and the outer legs of the insulating plug wires are insulated. A primer tin is then taken and fitted with two detonators arranged "in series." After the detonators have been carefully tested the priming charge of dry guncotton is placed in the primer tin, the detonators are inserted, the mouthpiece screwed up tight and the primer is lowered into the mine. Care is taken that no undue force is used and that the ends of the wires are carefully insulated and kept clear of any battery. After the primer tin is in place, the mouthpiece of

the mine is screwed in and the insulating plug properly screwed into it. Lastly the dome is screwed on and the chains shackled on to the mine.

The mines are kept moored to the bottom by means of sinkers and mooring ropes. The buoyancy of a 500-pound observation



Line of Observation Mines

mine, being 100 pounds, it is necessary to have mooring of some considerable strength, especially if the mine is laid in a strong tideway or current. The sinker weighs about 500 pounds. It is made of wrought iron and is circular with a nearly flat top and curved bottom. Its diameter is about two feet, the thickness varying according to the weight. The bottom of the sinker is slightly concave so as to give greater hold and suction on the ocean's bed. The top has three lugs to which the mooring ropes and trippers for exercise are secured. The mooring ropes are made of flexible steel wire rope, of about 2-inch size, and with a breaking strain of about six tons. When mining for exercise a tripper chain is stopped along the cable, of sufficient length to reach from the sinker to the winch in the boat, to enable the sinker to be weighed without in any way damaging the cable.

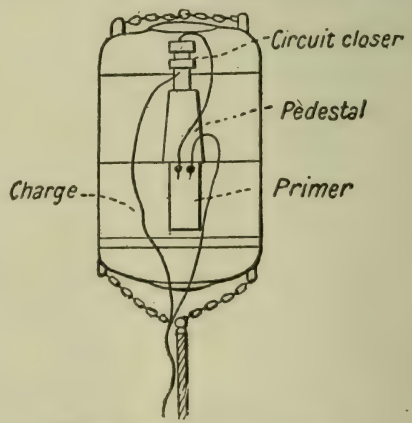
Special launches are generally provided for laying observation mines. The mines are usually laid in lines of six mines to the line. The two ends of the line are marked by a buoy at each end. To deceive the enemy various buoys are laid all about the mine field, but the operator on shore, of course, has the proper buoys accurately in sight and in line. When the enemy passes between the two-mark buoys of any particular line of mines the firing key of the battery is pressed and the line of mines fired.

In laying the mines particular care is taken that they are never less than 12 feet above the cable as it has been found by experiment that the explosion of the mines nearest the battery has in some cases cut the cable before the mines further along the line have fired. The best depth of a 500-pound observation mine below the surface is about 50 feet.

ELECTRO-CONTACT MINES.

Electro-contact mines are intended for explosion when in actual contact with the ship's bottom and hence there is no need for it to contain such a heavy charge as the observation mine. The explosive charge of an electro-contact mine is about 75 pounds of wet guncotton sufficient to sink the most powerful war vessel. It is so absolutely under the control of the operator that it can be put out of action immediately by the very simple process of disconnecting the firing battery. On the other hand its peculiar construction prevents its being fired unless in actual contact with the ship's bottom or unless subjected to a very severe blow.

The electro-contact mine consists of a cylindrical iron case with its ends rounded off and the outside fitted with eyebolts for connecting the sinkers to it. The charge is stowed in copper cases, the center one having a hole in it for the reception of the primer tin. The bottom of the mine is fitted with an insulating plug, the wires being rove through the insulating plug and eight feet long, one of them being marked to distinguish it from the other. In the center



Electro-Contact Mine

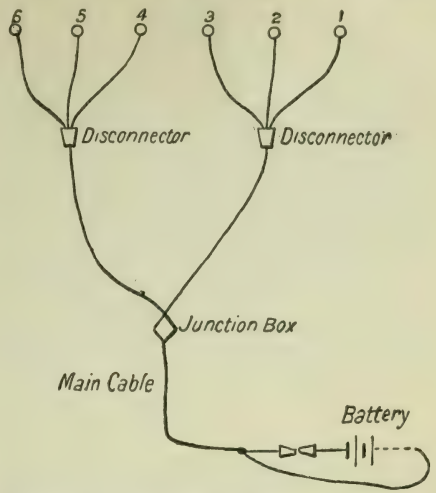
of the mine and over the charge is a platform on which is fixed a pedestal, and on top of this pedestal stands what is termed the "circuit closer." The purpose of this instrument is to complete the electric circuit when the mine is struck by a passing ship. The circuit closer used in the navy

consists of a vertical steel cylinder and, passing through the mouthpiece and insulated from the body of the cylinder, is an iron spindle which points down into the tube. The lower part of the cylinder is filled with the purest re-distilled mercury up to a point just below the other end of the spindle, to such a height that when the circuit closer is tilted over to an angle of 70 degrees but not less, the mercury should come into contact with the spindle, and by doing so should complete the circuit running through the wires connected with it. The greatest care has to be taken that the mercury is kept perfectly clean and dry, otherwise a scum of oxide forms on its surface and prevents the contact being perfect.

Electro-contact mines are laid in groups of three, each group with its three connecting cables being brought to a disconnector box, the latter being in turn connected by connecting cables to a multiple junction box at the end of the multiple cable. The purpose of the disconnector box is to cut a mine out of circuit after it has been fired by contact, so that when the circuit is completed in another mine it will not be short-circuited by the broken ends of the exploded mine; the disconnector of each mine is therefore in series with that mine, the bridges fusing simultaneously. The box is closed and made water-tight by means of a mouthpiece similar to that used to close up a primer tin in an observation mine.

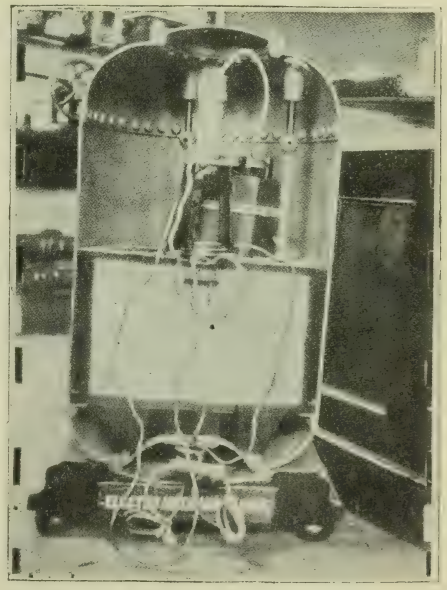
The junction box is simply an iron box containing the junction of the main with the branch cables. The ends of the cables are "puddinged," drawn together and connected inside the junction box. The puddings of the branch cables are nipped by hooks which have their lower ends threaded and screwed down by a nut outside the box. The cable used in the navy for electro-contact mines is similar to that used for all other mining and is 1,000 yards long. It is cut into eight lengths, six lengths of 100 yards and two lengths of 200 yards, and puddings are formed at each end. As will be seen from the diagram, each mine is connected with its disconnector box by a 100-yard length, and each disconnector box is connected to the multiple junction box by a 200-yard length. The main cable between the junction box and the battery is a 7-core one of the same pattern as that which is used with observation mines.

The shore or observation end of the cable has a firing battery of twenty boat's cells connected up to it, the core and armoring of the cable being taken to the opposite



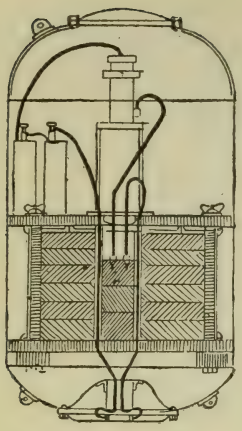
Plan of Laying Electro-Contact Mines

terminals. When it is wished to place the mines in action, the battery is plugged into the circuit and closed, and all that is then required is the bumping of one of the mines



Electro-Mechanical Mine Showing Interior

by a passing ship, and the consequent completion of the circuit by the tilting of the



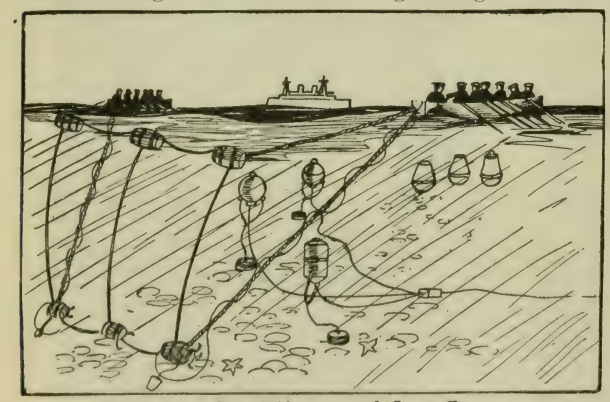
Electro-Mechanical Mine

mercurial circuit closer. The act of doing this fires the detonators and the mine.

ELECTRO-MECHANICAL MINES.

Electro-Mechanical mines are the most dangerous type of all, at least to their users. Each mine after being laid is left entirely to its own devices, being under no control whatever of the operator. They are not used for the defence of harbors, but for blocking entrance to an enemy's port and the one great advantage about them is that they can be laid expeditiously either from a ship or a boat in any position or order.

In construction the electro-mechanical mine is identical with that used for electro-contact mining, the same mine being used for either purpose; the battery of the electro-mechanical mine, however, being inside the mine and consisting of two boat's cells A short wire leads from the upper terminal of the circuit closer to the terminal of one of the boat's cells; another short wire leads from the lower terminal of the circuit closer to one of the detonators in the primer. The two inner legs of the wires leading through the insulating plug are connected to the terminal of the other boat's cell and the other detonator respectively. In the base of the mine, outside the insulating plug and protected by the protecting plate, is placed what is called a circuit breaker, into which the two outer short legs of the insulating plug wires are fitted. This current breaker consists of a brass cylinder in which work the ebonite disks with two insulated wires fitted at their inner ends with copper disks. Between these disks is poured a certain quantity of melted sugar, which is allowed to harden and thereby insulate the two disks from one another. When the mine is lowered into the water this cake of sugar is gradually dissolved and the ends of the two wires come together, thus completing the circuit; or rather the circuit is completed when the mine is tilted and the mercury in the contact closer touches both its terminals.



Fishing for Mines with a Sweep

MINE DESTROYING.

When mines have been laid it becomes necessary for the enemy to destroy them before it dares to enter the harbor. This is a most dangerous undertaking and is carried on with carefully considered scientific principles. The generally employed method of "mine destroying" is by means of countermining. This consists in the destruction of a mine field by laying a fresh line of mines across it and exploding them. When this task is successful and all the mines are exploded nearly simultaneously there is a great commotion and tons of water are hurled high in the air as if it were from the eruption of a volcano at the bottom of the sea.

A line of countermines usually consists of twelve 500-pound mines of the same pattern as observation mines. The cable is cut in the same way as the cable in the observation mine circuit—namely, 1,440 feet long with six branches 60 feet long forked into it at intervals of 180 feet, the two ends being 90 feet long and 450 feet long respectively, and as two of these circuits are used for the 12 mines, a line will clear a channel 720 yards long. The firing battery consists of two lots of 80 boat's cells, one at each end of the cable.

"Sweeping" and "creeping" are other methods of mine destroying. In sweeping, the mines are fished for by means of a sweep attached to two boats and when the sweep encounters an obstruction, which is determined by a pulling on the lines, the charges of guncotton attached to the sweep are exploded by means of a firing battery on the boat. It

The Mine in Naval Warfare. Explosion of a Line of Mines by Countermining

takes several sweeps to clear a channel of mines and the process is not very satisfactory.

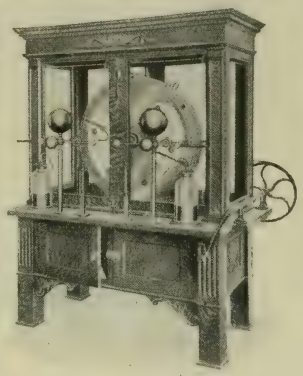
"Creeping" is one of the most efficacious modes. The object in creeping is not to catch the mines themselves, but the electric cables and therefore the operation is usually carried on near the shore where the cables are liable to be found lying in comparatively shallow water. After the cables are severed by exploding grapnel, the severed line is caught up, connected to the firing battery on the boat and the mines thus discharged.

Some Facts About X-Rays

By N. O. Nelson

The prevailing idea in the minds of most people regarding the X-ray is that it is the light of great brightness—something far surpassing, but in the nature of an electric arc lamp or calcium light. They argue that as it is able to penetrate nearly all substances opaque to ordinary light, it must be powerful indeed and should appear so to the naked eye. Nothing is further from the fact, for, on the contrary, the X-rays are invisible to the eye, and the passing of the rays are only known by the effects they produce and by interposing in their path certain chemical substances which have the power to "fluoresce" or show phosferininse. To produce that phenomena known as the X-ray, an electric current of extremely high pressure or electro-motive force and comparatively small quantity or amperage is sent through a glass tube which is exhausted of nearly all air and is therefore almost a complete vacuum. A "Geissler" tube or the ordinary incandescent electric light bulb is also exhausted to a degree, but falls far short of the vacuum required in a Crooke's X-ray tube. A static machine, either of the type known as the Wimshurst or the simpler Toepler-Holtz, generates the right kind of electricity. A Rhumkorf coil, which simply transforms a low energy current into one of greater energy, is commonly used to excite or illuminate a Crooke's tube. The static machine or coil transformer bears the same relation to an X-ray tube that the dynamo does to an incandescent lamp. The X-ray is but little used outside of the medical profession. The physician finds it useful not only to locate bullets, needles or the buttons baby has swallowed, but also in repairing broken bones. After a job of bone-setting is done he can watch the progress of knitting and see if it goes on satisfactorily or not. Last, but not the least of the properties of the X-ray, is its ability to destroy ulcerous growths of various kinds in the human body. Malignant tumors and certain skin diseases are readily healed by exposure to the X-rays. Whether its action is a destroyer of bacteria and cell life or whether the rays simply render the substance upon which the parasite lives unfavorable to their growth, is yet to be determined. Much harm has

been done to the cause of the X-ray by its reputed burning qualities. The daily press gives hair-raising descriptions of how seriously this or that person was "burned" by the X-ray. Any time harm has been caused by the new light it can generally be traced to some one who applied it, ignorant of its power for good or bad. That the X-ray will destroy healthy tissue if exposed long enough to its action is not denied. Therein lies its power to heal. An X-ray burn is very similar to a sun burn. If you expose your bare back to the hot July sun for one-half hour daily for a week, you will have a serious burn, in many respects like an X-ray burn. To cause the latter, almost the same length of exposure is necessary. For a radiograph or X-ray picture of a hand, an exposure of but one second is now necessary with modern apparatus, while a view of the ribs or spine may be made in six to ten seconds, so the danger of a burn during a single exposure is indeed remote.



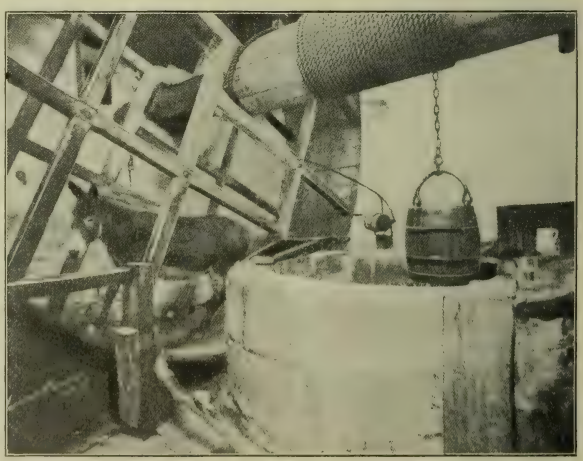
Nelson Static Machine

The process of making an X-ray picture is more simple than is generally supposed. The chloride of silver or a photographic dry plate is affected very quickly when exposed to the rays. No camera is necessary. A dry plate of sufficient size is wrapped in several thicknesses of black and yellow paper to protect it from ordinary light. Lay it on the table, sensitive side up, and place your hand or whatever object you want to photograph on it. Support your vacuum tube 8 to 20 inches above it and attach your current. (See page 195 of Snow's "Electro-Therapy.") The rays will penetrate the paper covering and the flesh of your hand, but the bones being of greater density make a shadow on the plate and leave the chloride of silver unaffected. To produce the finished picture, the plate is developed, dried and printed from in the ordinary manner. No substance has yet been found which can successfully resist the penetration of the X-rays. The metals come nearer to it than other materials. Lead, gold and platinum form the best resistance. Cast iron and brass are more easily penetrated, while aluminum is but little better than paper. The shadow of a coin behind six or eight inches of pine may be easily seen, even with very low power apparatus. Paradoxical as it may seem, clear glass offers almost the same resistance that iron does.

The fluoroscope offers the best means for detecting the presence and value of the X-ray. The fluoroscope in ordinary use consists of a light-proof box, one side of which is made of a screen or cardboard cover coated on the inside with fine crystals of platino-barium cyanide or tungstate calcium, which fluoresce brightly when exposed to the X-rays. The opposite end of this box has an opening shaped to fit tightly over the face, to exclude ordinary light. Any object opaque to the rays will cast its shadow on this screen when placed between it and the source of the rays.

AN ENGLISH DONKEY WHEEL.

For generations donkeys of a single line have trodden the great wheel shown in the cut. As the patient beast treads, the wheel revolves and winds or unwinds, as need may be, the strong cable from which the bucket is suspended—on the same principle as our own old-fashioned structures.



Donkey Wheel at Carisbrooek Castle

American Machinist says this well is located at an ancient castle in England and is 240 feet deep. A windlass on the side of the well is used for lowering a candle to show the depth.

Great Buildings of America

National Bank Of Commerce, St. Louis

The National Bank of Commerce Building is one of the pride structures of St. Louis. It was built in 1902 at a cost of nearly $1,000,000. It is twelve stories high and is entirely of stone and steel with marble and bronze finish. The structure is considered a skyscraper in St. Louis, where the people have not taken to tall buildings as they have in New York and Chicago. The basement and first, second and twelfth floors are used by the National Bank of Commerce, which has a capital of $7,000,000 and is one of the leading financial institutions of America. The twelfth floor is used as a restaurant for the bank officers and employes.

Pride Building of the World's Fair City

PROPOSED RAILWAY FROM WINNIPEG TO HUDSON BAY.

If, as is proposed, a railroad is constructed from Winnipeg to Hudson Bay, connecting there with a line of ocean steamers for all great ports, a new commercial route will have been opened which will prove of great industrial value to Canada and the United States. With better facilities for moving products, the development of vast areas must certainly follow. Lands for grazing purposes and for growing grain, vast forests of spruce, tamarack and poplar; building stone, minerals, fish of all kinds, oil from whales, porpoises and walruses; these are the riches the new road would make accessible. Two hundred million fertile acres are drained by the rivers and lakes finding their outlet on the west shore of Hudson Bay.

Popular Mechanics' special five-year subscription offer for $3 is proving exceptionally attractive. Those who find Popular Mechanics of interest and assistance to them should not fail to avail themselves of this chance. We will give the assurance to all that Popular Mechanics will continue to improve in the future as it has in the past.

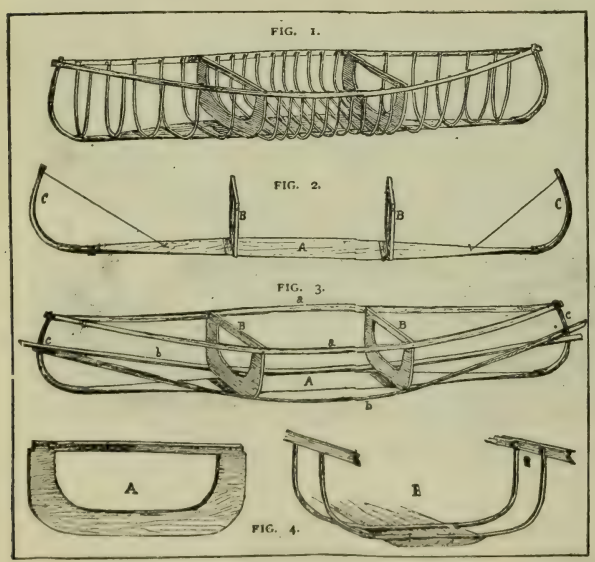
MECHANICS FOR YOUNG AMERICA

Rowing in a Paper Boat

How to Make a Paper Boat

It is Light and Can Easily Be Carried About.--A Barrel Sail Boat

Without a boat, successful fishing is nearly impossible under many conditions. Boats are expensive to buy, and they are heavy and bunglesome and often insubstantial. So why not have a perfectly successful boat suited to your own needs and one that is inexpensive, by making it yourself. It is difficult for an amateur boat-maker to obtain the right kind of lumber for the hull of a row boat, and after the lumber is obtained, it is still more difficult to cut it off and bend it in the proper shape for the boat. If you have not the facilities for making a wooden boat and if you want a light, serviceable boat, why not make it out of paper?



Now you might think it absurd to advise making a paper boat, but it is not, and you will find it in some respects and for some purposes better than the wooden boat. When it is completed you will have a canoe, probably equal to the Indian's bark canoe. Not only will it serve as an ideal fishing boat, but when you want to combine hunting and fishing you can put your boat on your shoulders and carry it from place to place wherever you want to go and at the same time carry your gun in your hand. The total cost of such a boat is $6.17. Here is how to make a paper boat:

Make a frame (Fig. 1) on which to stretch the paper. A board about a foot wide, an inch thick and say 11 feet 6 inches long is taken as a kind of keel, or backbone, and is cut tapering for about a third of its length, toward each

end, and beveled on the outer edges (A, Fig. 2). The cross-boards (B, B, Fig. 2) are next sawed from a pine plank one inch thick. Shape these as shown by A, Fig. 4, 13 inches wide by 26 inches long, and cut away in the center to avoid useless weight. Fasten them cross-wise to the bottom-board as shown in Figs. 1 and 2, with long stout screws, so as to divide the keel into three nearly equal parts. Then add the stem and stern pieces (C, C, Fig. 2). These are better, probably, when made of green elm. Screw the pieces to the bottom-board and bend them, as shown in Fig. 2, by means of a string or wire, fastened to a nail driven into the bottom. Any tough, light wood that is not easily broken when bended will do. Green wood is preferable because on drying it will retain, to a considerable extent, the shape into which it has been bent. For gunwales (a, a, Fig. 3), procure at a carriage factory, or other place, some light strips of ash, about 12 feet in length, 1½ inches wide, and ⅜ inch thick. Nail them to the cross-boards and fasten to the end-pieces (C, C,) in notches, by several wrappings of annealed iron wire or copper wire, as shown in Fig. 3. Copper wire is better because less apt to rust. For fastening the gunwales to the cross-boards use nails instead of screws, because the nails are not apt to loosen and come out. The ribs, which are easily made of long, slender switches of osier willow, or similar material, are next put in, but before doing this, two strips of wood (b, b, Fig. 3) should be bent and placed as in Fig. 3. They are used only temporarily as a guide in putting in the ribs, and are not fastened, the elasticity of the wood being sufficient to cause them to retain their position. The osiers may average a little more than a half-inch in thickness and should be cut, stripped of leaves and bark and put in place while green and fresh. They are attached to the bottom by means of shingle nails driven through holes previously made in them with an awl, and are then bent down until they touch the strips of ash (b, b, Fig. 3), and finally cut off even with the tops of the gunwales, and notched at the end to receive them (B, Fig. 4). Between the cross-boards the ribs are placed at intervals of two or three inches, while in other parts they are as much as five or six inches apart. The ribs having all been fastened in place as described, the loose strips of ash (b, b, Fig. 3) are withdrawn and the framework will appear somewhat as in Fig. 1. In order to make all firm and to

Boy Carrying a Paper Boat on His Shoulders While Hunting

prevent the ribs from changing position, as they are apt to do, buy some split cane or rattan, such as is used for making chair-bottoms, and, after soaking it in water for a short time to render it soft and pliable, wind it tightly around the gunwales and ribs where they join, and also interweave it among the ribs in other places, winding it about them and forming an irregular network over the whole frame. Osiers probably make the best ribs, but twigs of some other trees, such as hazel or birch, will answer nearly as well. For the ribs near the middle of the boat, twigs five or six feet long are required. It is often quite difficult to get these of sufficient thickness throughout, and so, in such cases, two twigs may be used to make one rib, fastening the butts side by side on the bottom-board, and the smaller ends to the gunwales, as before described. In drying, the rattan becomes very tight and the twigs hard and stiff.

The frame-work is now complete and ready to be covered. For this purpose buy about 18 yards of very strong wrapping-paper. It should be smooth on the surface, and very tough, but neither stiff nor very thick. Being made in long rolls, it can be obtained in almost any length desired. If the paper be one yard wide, it will require about two breadths to reach around the frame in the widest part. Cut enough off the roll to cover the frame and then soak it for a few minutes in water. Then turn

the frame upside down and fasten the edges of the two strips of paper to it, by lapping them carefully on the under side of the bottom-board and tacking them to it so that the paper hangs down loosely on all sides. The paper is then trimmed, lapped and doubled over as smoothly as possible at the ends of the frame, and held in place by means of small clamps. It should be drawn tight along the edges, trimmed and doubled down over the gunwale, where it is firmly held by slipping the strips of ash (b, b) just

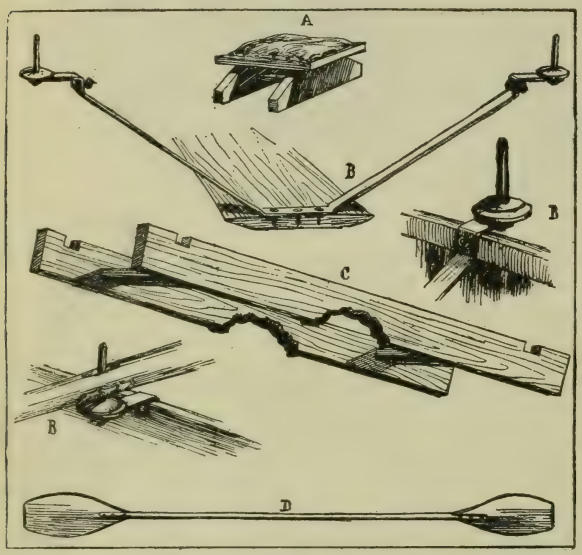


Fig. 5.

inside of the gunwales into notches which should have been cut at the ends of the cross-boards. The shrinkage caused by the drying will stretch the paper tightly over the framework. When thoroughly dry, varnish inside and out with asphaltum varnish thinned with turpentine, and as soon as that has soaked in, apply a second coat of the same varnish, but with less turpentine; and finally cover the laps or joints of the paper with pieces of muslin stuck on with unthinned varnish. Now remove the loose strips of ash and put on another layer of paper, fastening it along the edge of the boat by replacing the strips as before. When the paper is dry, cover the laps with muslin as was done with the first covering. Then varnish the whole outside of the boat several times until its presents a smooth shining surface. Then take some of the split rattan and, after wetting it, wind it firmly around both gunwales and inside strip, passing it through small holes punched in the paper just below the gunwale, until the inside and outside strips are bound together into one strong gunwale. Then put a piece of oil-cloth in the boat between the cross-boards, tacking it to the bottom-board. This is done to protect the bottom of the boat.

Now you may already have a canoe that is perfectly water-tight, and steady in the water, if it has been properly constructed of good material. If not, however, in a few days you may be disappointed to find that it is becoming leaky. Then the best remedy is to cover the whole boat with unbleached muslin, sewed at the ends and tacked along the gunwales. Then tighten it by shrinking and finally give it at least three coats of a mixture of varnish and paint. This will doubtless stop the leaking entirely and will add but little to either the weight or cost.

Rig the boat with wooden or iron rowlocks (B, B, Fig. 5), preferably iron, and light oars. You may put in several extra thwarts or cross-sticks, fore and aft, and make a movable seat (A, Fig. 5). With this you will doubtless find your boat so satisfactory that you will make no more changes.

For carrying the boat it is convenient to make a sort of short yoke (C, Fig. 5), which brings all the weight upon the shoulders, and thus lightens the labor and makes it very handy to carry.

The approximate cost of materials used in the construction of the canoe are as follows:

Varnish, 5 qts.	$1.90
Paper, 18 yds.	1.20
Cloth, 8 yds.	.72
Bottom-board	.60
Gunwales	.50
Cross-boards	.25
Paint	.50
Split rattan	.25
Nails, screws, wire, etc.	.25
Total	$6.17

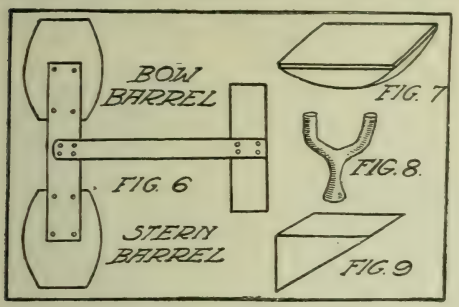
It may be that you are in position to get many of these materials for nothing and thus lessen the cost.

BARREL BOAT FOR SAILING.

For sailing the barrel boat is very easily constructed and it is one of the best devices known to instruct a young person in the art of managing sails. The barrel boat can be put together in one day, and the only part that needs to be bought is the material for the sail. Fig. 6 shows the hull of the barrel boat. It consists of a bow barrel and a stern barrel, joined together by one strong plank and a simple outrigger which extends

from the plank. In order that the barrels may not present a flat front, which would be difficult to push through the water, they are, as shown in the illustration depicting the completed boat, fastened to the plank at an angle. The angle is made by placing between each barrel and the plank a triangular shaped brace, such as shown in Fig. 9. Both barrels must be covered with tar and painted so that they will be absolutely water-tight.

The outrigger (Fig. 7), is a small scow-



Rigging of Barrel Boat

shaped affair, about 2½ feet long and 1 foot wide. An ordinary oar or paddle is used for steering. A notched stick (Fig. 8) or an iron rowlock can be fastened over the stern barrel to hold the steering oar.

The barrel boat, when completed, will consist of two large air-tight compartments

Sailing in a Barrel Boat

and is, therefore, unsinkable, and because of the out-rigger is very difficult to tip over. Hence it is safe to carry quite a large spread of sail. In a stiff breeze the barrel boat is more seaworthy than rapid, because the waves slap against the ends of the barrels, but in a light breeze when the water is smooth, the barrel boat compares favorably in point of speed with the ordinary small sail boat.

HOW TO MAKE A WATER WHEEL.

Considerable power can be developed with an overshot water wheel erected as in Fig. 1. This wheel is made with blocks of wood cut out in sections as indicated by the lines, so as to form the circle properly. The wheel can be about 24 inches in diameter with

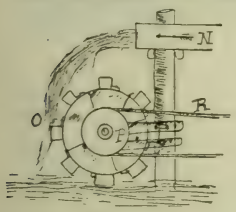


Fig. 1

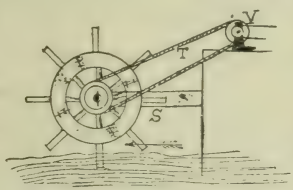


Fig. 2

good results and about 10 inches wide. Get some tin cans and attach them around the wheel as shown. Bore the wheel center out and put on the grooved wood wheel P and a rope for driving R. This rope runs to a wooden frame in the manner illustrated and the water is carried in a sluice affair N to the fall O, where the water dippers are struck by the volume and a power equal to two to four horsepower ordinarily generated. This power can be used for running two or three sewing machines, fans, fret-saws, and the like. Another form of water wheel is shown in Fig. 2. This is driven by an underflow of current. This type of wheel can be made on lines similar to the other, only that the paddles are of wood and extend outward as shown. The wheel is supported in a bearing on the piece S. A belt T communicates the power to the wheel V and from here the power is carried to any desired point.

To find the horsepower which a belt can safely transmit, multiply the diameter of the driving pulley in inches by the revolutions per minute, and by the width of the belt in inches. Divide the resulting product by 3,300 for single belting, or 2,100 for double belting.

A Hungarian inventor claims to have solved the smoke difficulty by employing porous plates or bricks made of a composition containing lime and fuel of different degrees of combustibility arranged behind or between portions of the fuel in a furnace. These serve as desulphurizing or purifying filters for the furnace gases.

"War Airship" to Destroy Russian Fleet

Californian Claims His New Aerial Craft Can Rain Dynamite on War Vessels From Its Height in the Clouds

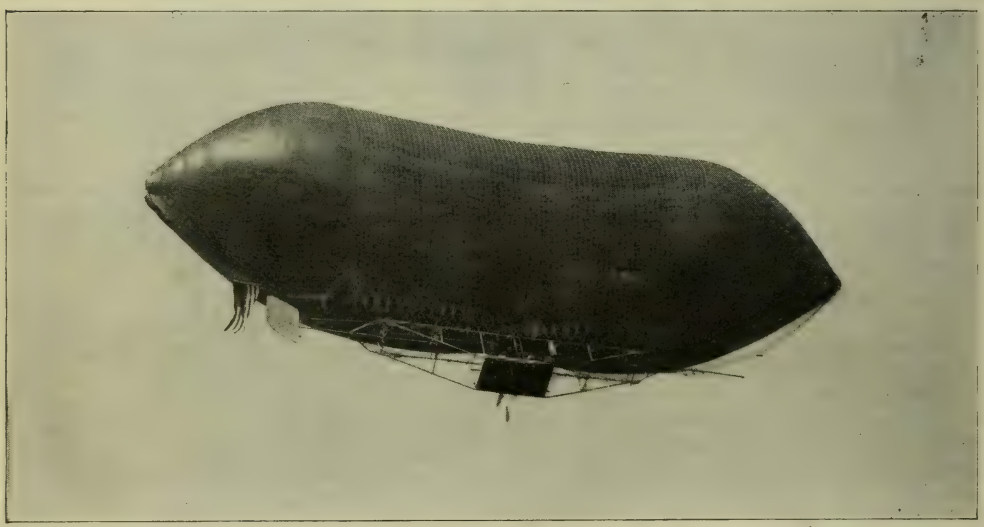
Destruction of the Russian fleet by means of an airship is a plan conceived by Dr. Greth of California and for this purpose he has built an aerial craft, termed the "California Eagle." The Japanese government has entered into negotiations with the inventor and will purchase the "war airship" provided that the final test, to be made at San Francisco in a few days proves all the inventor claims for it. An old barge will be anchored off the Heads of Golden Gate, when Dr. Greth and Captain Baldwin, of the United States Army, will attempt to show the agents of the Japanese government how a battleship may be destroyed by dropping dynamite from the airship, which at all times will be kept out of range of the enemy' guns.

The result of the experiment may be of great importance to the science of war in all nations.

In the preliminary tests the "war airship" has proved itself most successful. It was able to rise to any desired altitude, was easily steered and without difficulty was driven in any direction. Dr. Greth finds that his craft has suffered some disadvantage from the 5-horsepower engine he employed to propel it. Hence he is building a new engine of more than 40-horsepower which will be ready for use soon.

The balloon of the "California Eagle" is cigar-shaped, 80 feet in length, with an extreme diameter of 25 feet, having a capacity of 50,000 cubic feet of hydrogen gas. Suspended directly underneath in a central line, is the cage, the structural material of which is steel tubing.

The guiding power is incorporated in twin, sheet steel, eight-blade, screw propellers, six feet in diameter, arranged on either side, amidships, and capable of performing about 1,800 revolutions per minute. They are under control of the steering gear in the car, and, aside from their propulsive power, operate in lieu of a rudder, although a canvas rudder is also used as an auxiliary. They can be deflected at any angle without stopping or reversing the engine, and, according to the angle at which they are placed, the ship can be moved in any direction, which the inventor claims no other builder of an airship has ever accomplished with such a degree of simplicity. The propellers run in ball bearings and their axis is rotated and changed by means of a mechanical worm and worm wheel. Santos-Dumont has but one propeller, fixed and



"War Airship," the California Eagle

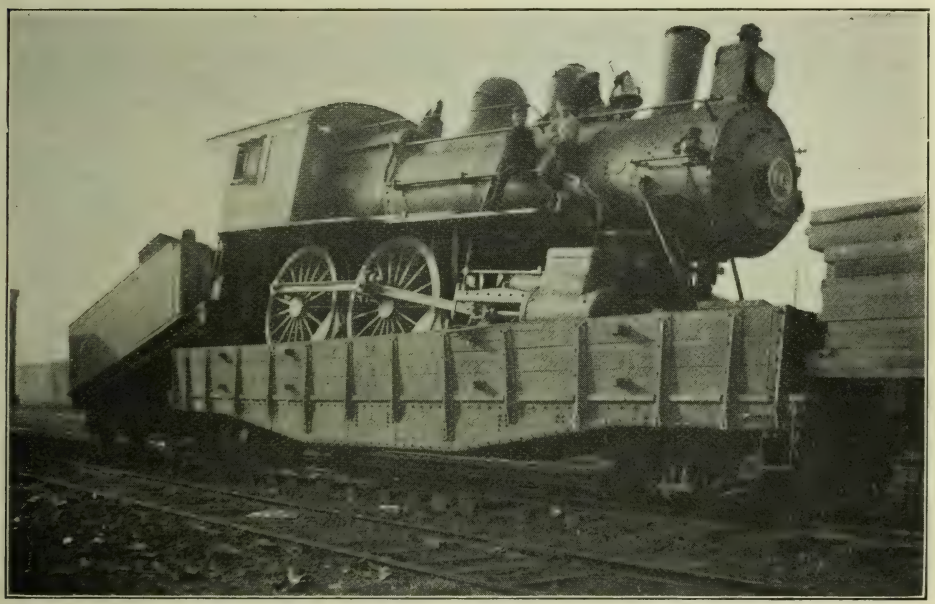
rigid, and steers with a canvas rudder, which, Dr. Greth says, does not take action rapidly until the ship is under considerable headway.

Dr. Greth claims that under anything like favorable conditions, he can drive his ship forward at a speed of from 30 to 40 miles per hour.

ODD ACCIDENT ON THE PENNSYLVANIA.

Results of the Mix-up Prove the Greater Strength of Modern Rolling Stock

An accident that happened on the Pennsylvania railroad at Harrisburg, Pa., recently, demonstrates the increased strength and durability of railroad rolling stock. A Pennsylvania engine weighing 134,000 pounds ran into a gondola car of 100,000 pounds capacity. The engine rode right up into the car and there stopped as contentedly as if it had merely been stationing itself for a little ride about the Pennsylvania yards. The fireman and engineer recovering from their fright and seeing the damage was insignificant walked out on the running board and there had their pictures taken for the Railroad Trainmen's Journal and Popular Mechanics. The only damage resulting from the mix-up was a broken pony-wheel truck.



Locomotive Climbs Into a Gondola Car

Plans have been decided on for leveling the tunnels under the Chicago river without interrupting traffic through them.

PATENT FOR COLOR PHOTOGRAPHY.

Johns Hopkins Professor Invents Process of Taking Pictures of Different Shades

After five years of investigation the patent office has granted to Dr. Robert W. Wood, professor of experimental physics at Johns Hopkins University, a patent covering all rights to color photography. The five years of investigation by the patent office consisted in an exhaustive research to ascertain the rights of the process to an exclusive patent which this affords all processes based upon it. The patent will protect Dr. Wood's rights upon the derivative invention. There are several photographers who claim to be the discoverers of color photography.

The process at present is valuable from an academic standpoint. The photographs cannot be made on paper, but only upon glass slides, and a special viewing apparatus or electric lantern upon a screen must be used to get the optical results. Duplicates are easily made.

EASY ELECTRICAL EXPERIMENTS

A SIMPLE ELECTRIC ENGINE.

The first electric motors were built on lines similar to the steam engine—employing a reciprocating motion similar to that of a piston, this motion being converted into rotary motion by means of a crank and fly-wheel. For a simple machine, this is still an interesting form of motor, and may be made with very little labor and expense.

It is well known that a coil of wire carrying an electric current exerts a magnetic attraction upon a piece of soft iron placed in its neighborhood. If one end of an iron rod is placed near the end of the coil, the coil tends to draw the whole rod within itself in much the same manner as a piston is pushed within a cylinder. The machine to be described employs this principle.

Two coils shown at A and B will be required. The spools for these coils are made of brass. Take a piece of brass tubing, whose inner diameter is ⅝ inch, and whose length is 3 inches. To each end of this tube solder two circular heads also of brass. These heads are ⅛ inch thick, and 1¾ inch in external diameter. In the center of one of them is a hole ½ inch in diameter. The brass spools thus formed are to be mounted as shown in the accompanying figures, so that the ends with the holes are facing each other, being supported at their outer ends by a brass yoke bent into the form of the letter U. This yoke should be made of ¼ inch material so as to be very stiff Its extreme outer dimension from left to right is 10¾ inches, and the upright arms project 4¼ inches above the base. The coils A and B are fastened to this support by means of two brass screws. Some trouble may be experienced in getting the two coils exactly facing each other, and in line. This can be the more easily accomplished by fastening one of them in place; then take a piece of straight iron rod, ½ inch in diameter and 9 inches long, and insert it in the holes in the ends of the spools. This will force the spools into line, and the screw-holes for the second spool may be located. When in place, the rod should slip freely back and forth, into and out of the coils, without striking against the spools at any point. After being thus mounted, the spools may be wound full of number 24 double cotton-covered magnet wire.

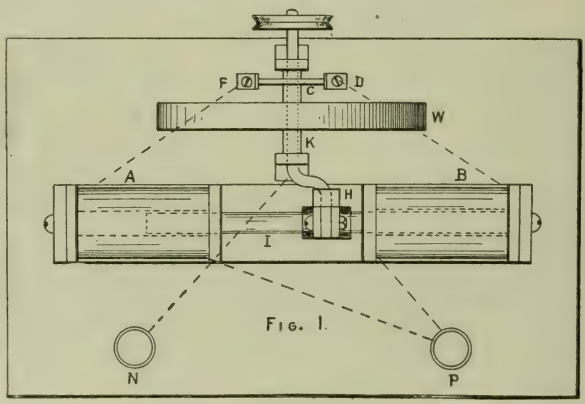


FIG. 1.

From the piece of ½-inch iron rod already mentioned cut off two pieces 4 inches in length. Thread one end of each of these for a distance of 5/16 inch from each end. To the threaded end of each rod is to be fitted a piece shown at E, Fig. 2. This piece is built up from a circular brass piece ¾ inches in diameter and 5/16 inches thick, soldered to the center of a strip of brass, 3 inches long, ¾ inch wide and ⅛ inch thick. The circular piece is bored and tapped at its center so that the whole may be screwed into place on the end of each of the iron rods. In Fig. 2, one of these rods is shown at I, with the end pieces shown at E. Between the two end pieces, which face each other, are two small blocks of brass, ¼ inch thick, ½ inch wide, and ¾ inch long. These are inserted between the two pieces E and F, Fig. 2, and a small bolt passing through the whole fastens them together. It will be necessary too, to pin the pieces in place, to prevent them from racking out of place when the motor is running.

A fly-wheel of some kind, about 6 inches in diameter will be required. It is to be mounted upon a shaft ¼ inch in diameter and 6 inches long. This shaft is supported in brass bearings, at such a height that its center is on a level with the center of the rod which moves in and out of the coils. Heat the shaft red hot, and bend one end over to form a crank, whose throw is ¾

inch. The end of this crank is to fit into the slot at S, so that as the rod I moves back and forth, the crank may revolve smoothly without binding at any point. A little filing and bending will secure this result.

In Fig. 1 the wheel is shown at W mounted on the shaft, between two bearings. A sleeve, shown at K, driving tightly upon the shaft, prevents end play in one direction. Another sleeve, shown at C, performs the same office on the other side of the wheel, but it is of special construction. Its form is shown in the upper portion of Fig. 2. A piece of brass tubing, fitting tightly to the shaft is cut of such a length that it will fit into the space between the wheel and its bearing. To this sleeve is soldered a thin piece of brass, at right angles, its outer rim being circular, and extending nearly half way around the sleeve. It may be best to make it an exact semi-circle at first, and then to reduce it by filing.

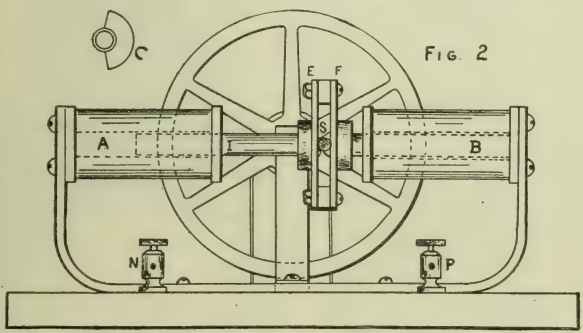


FIG. 2

This is a contact piece, upon which the action of the motor depends. As shown in Fig. 1, two springs D and F press upon this contact piece

Now these contacts should be made at such a time as to assist the motion of I as it moves to and fro.

That is, as I starts to move into A, contact should be made so that a current flows in A, tending to draw the iron core into the coil. As soon as I has gone to its extreme left-hand position, the circuit through A should be broken. Then as the iron rod starts toward the right, the current should be switched into B. As the springs D and F must have a little movement, so as not to be too stiff, the contact strip C should be a little less than half a circumference in length.

Five cells of a good dry battery will be necessary to run the motor or eight cells of gravity battery.

In order to prevent the rod I from turning about its own axis while running, a piece shown at H, Fig. 1, is slipped on to the crank inside of the slot. This piece is ½ inch in diameter and ½ inch thick and should drive tightly upon the shaft.

AMERICA'S LARGEST BATTLESHIP LAUNCHED.

The Virginia Slides Gracefully Into The Water While 30,000 People Cheer

The battleship Virginia, the largest vessel in the United States navy, was launched at Newport News April 5 in the presence of 30,000 persons, who cheered vociferously as the trim though monster fighter slid gracefully into the water. The battleship was christened by Miss Matilda Gay Montague, daughter of the Governor of Virginia.

The Virginia has a displacement of 14,600 tons, whereas the Maine and Missouri, recently added to the navy, have a displacement of 12,500 tons. The Virginia is 3,000 tons displacement greater than the Illinois, Wisconsin, Kentucky or Kearsarge, and 4,375 tons greater than the Oregon.

Big as is the Virginia, however, Uncle Sam will soon launch five battleships, the Connecticut, Kansas, Louisiana, Minnesota and Vermont, each 16,000 tons displacement, or 1,400 tons greater than the Virginia. The United States has twelve more battleships under construction yet to be launched, and one, the Ohio, launched but not ready for a trial trip. When all are completed Uncle Sam will have 25 battleships afloat—a number exceeded by only two navies in the world, the British and the French.

The battleship Virginia will have 24 big guns in its main battery and will be driven by engines of 18,000 horsepower. It is to have a contract speed of 19 knots. Its cost, completed, will be $3,590,000 .

Prof. Myers, superintendent of the aeronautic field at St. Louis, states the field now occupies twelve acres, and the field equipment will consist of aerodrome stalls, a two-story shed addition running along the entire north side of the field for offices, a sewing room, laboratory, machine and wood shops, storage rooms, ballast quarters and dormitory and living rooms for crews in charge of the airships in commission.

The Limit of Daring Amusement Feats

Human Missile on a Bicycle Is Hurled 56 Feet Through the Air, Lighting On a Narrow Platform

Leaping 56 feet through the air on a bicycle and 22 feet above ground, "Volo, the Volitant" has outdared all the daring and surpassed all the performers of reckless feats for the amusement of a sensation-loving public. "Looping-the-loop," "circling-the-circle" and other of the hazardous stunts of trick bicyclists are completely overshadowed by this latest and boldest of amusement exploits.

Starting from a point 45 feet from the ground, Dr. Clark mounts a 170-pound bicycle, set at an angle of 45 degrees and after attaining a velocity estimated at 85 miles an hour, machine and rider are thrown into the air by a sudden rise at the bottom of the plankway. The terrific momentum carries the performer, still upright on his bicycle, into the air to a height of 22 feet from the ground and across a gap in the staging 42 feet wide. The total distance traveled through space along the arc of the circle described by the human missile is calculated at 56 feet.

Hanging for an instant in the air with

Looping the Gap

the front wheel of his machine pointing skyward, the performer suddenly throws his head forward with the same motion used by throwing a forward somersault. This brings both wheels on a level just as the bicycle strikes the landing platform, which is seven feet above the ground. The machine seems to regain its lost impetus and shoots down an incline to the ground level where it is stopped by a "mechanic" placed 50 feet away.

The time elapsing from the instant that Dr. Clark starts on his perilous ride until he reaches the ground after his flight through space is just 4 1-5 seconds.

SPRING HEELS FOR MOTORMEN.

Motormen are the beneficiaries of the recent invention of a spring sandal to relieve them from the bad effects of constantly

Motorman's Shoe

vibrating cars. Coil springs at the heels, their tension increasing in proportion to the weight of the wearer, and hard rubber pieces for the ball of the foot are the main features of this device which has met the approval of railway company officials and physicians. The sandal weighs but 15 ounces, excluding the possibility of its being cumbersome.

For winter use overshoes along the same lines will probably take the place of the sandal.

Chicago's freight tunnel system is now being used to remove excavated material from sites of downtown districts. The tunnel cars will remove all the material from the site of the new Chicago Savings Bank, where the excavation will be to a depth of 40 feet below the sidewalk. Excavated clay will be lowered by caissons to the cars of the tunnel company, switched underground to the lake and transferred to Grant Park.

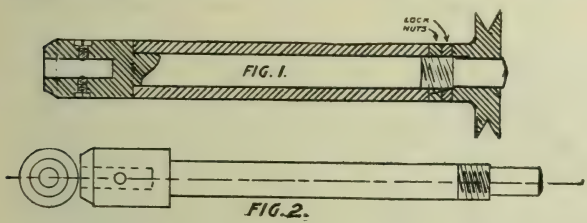
Lathe Attachments

Copyrighted 1904 by W. W. Wood.

Part I. General Introduction and Description of Division Plate and Pointer.
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle.
Part V. Gear Wheels and Rotary Cutters.
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

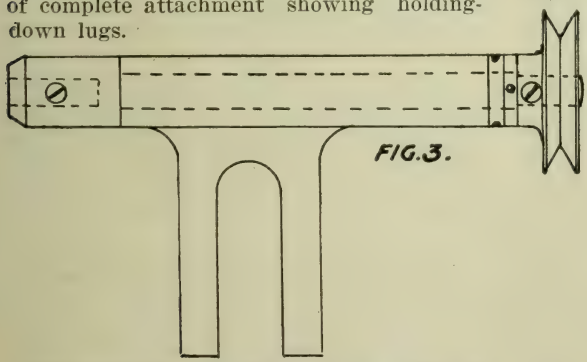
MILLING AND DRILLING SPINDLE.

For use in connection with the overhead described heretofore the milling and drilling spindle becomes a very useful accessory to the lathe and in many instances will take the place of an ornamental or eccentric chuck.

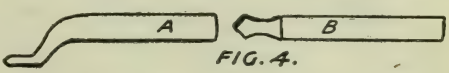


The one shown herewith is easily constructed and can be used in connection with a revolving cutter or various shaped drills, two specimens of which are shown at a and b, Fig. 4. A, Fig. 4, is a crank drill used for ornamental work, as for instance, decorating a box cover, as shown in Fig. 5. B, Fig. 4, is an ordinary straight shanked drill and needs no further description.

Fig. 1 is a sectional view of attachment with a semi-sectional view of the spindle showing chuck on the end, and method of fastening drills. Fig. 2 shows the spindle with end view of same and Fig. 3 is a plan of complete attachment showing holding-down lugs.



Two patterns are required to construct the attachment, one for the frame and one for the pulley. The frame is either cast solid or can be cored and reamed out to size to fit the shank of spindle easily, but without shake. If cast solid, bore the hole with a twist drill and run a reamer through so as to make a true hole throughout. Face the ends true with the bore. The spindle is turned with a steel or iron rod as shown, threaded at one end to take the two lock nuts shown in section at Fig. 1. The nuts should be turned and provided with tommy holes by which to tighten up. Fig. 5 shows a specimen of work that can be done, and is executed in the following manner: The circular disk or work is secured to the faceplate or on chuck on lathe mandrel. The drilling spindle with a crank drill is bolted on the slide rest so that center of spindle is on a line with center of lathe spindles. The division plate on lathe is used. Advance the drill to work and make the first circle, cutting to proper depth, and then make a chalk mark on han-



dle of slide rest to serve as a guide to insure all circles being cut to same depth.

When the first circle is cut draw back the tool and using division plate, turn the work proper distance and cut the second

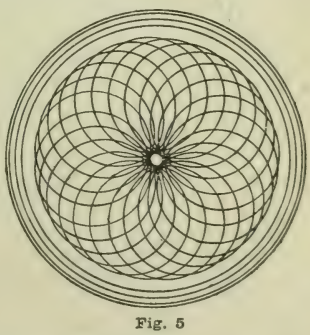


Fig. 5

circle. Continue thus until the work is completed. The specimen shown is composed of 24 circles. Many different designs

will occur to the workman as well as a variety of uses to which the spindle may be put.

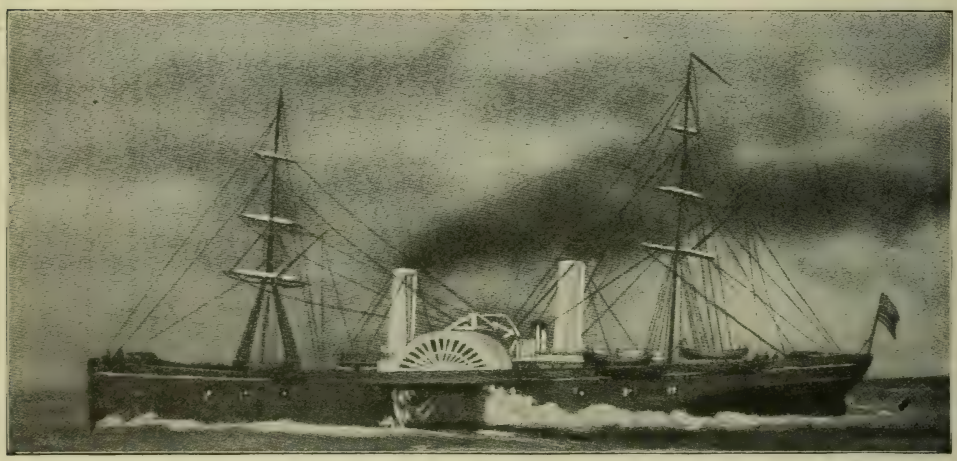
THE UNITED STATES STEAMER VANDERBILT.

When, during the greatest stress of the Civil War, Cornelius Vanderbilt presented the crack liner, Vanderbilt, to the United States, the craft was admitted not to the Navy, but to the Army. The distinction was a bit of diplomacy by President Lincoln, for, due to the Commodore's stipulation that he have charge of the vessel and direct all her movements, it came near being lost to the government. The Navy could not admit a vessel under the control of a civilian and Mr. Vanderbilt's condition was positive.

President Lincoln, on hearing of the difficulty, summoned Mr. Vanderbilt to the White House and after greeting him accepted his gift with a few words of thanks; then, knowing the stipulation made it impossible to enter the ship in the Navy, added: "I will place her with the Army and assign her to the Quartermaster Department and put you in charge."

The original intention was to fill the Vanderbilt with empty casks and deliberately run her upon the Merrimac and thus sink that ship; the Vanderbilt was not used for this purpose, however, and after the Merrimac was blown up, the Vanderbilt was admitted to the Navy and placed in charge of a naval officer, the Commodore not wishing to command her after the destruction of the ironclad.

The Vanderbilt made a brave showing in several engagements, and a gold medal and a vote of thanks were awarded by Congress to Mr. Vanderbilt, an unusual distinction. In fact, the whole affair is without precedent in the history of a nation.



The United States Steamer Vanderbilt

KNIFE WORTH $5,000.

The Westminster Gazette says: "The most valuable knife in the world is to be seen in the collection of a famous firm of cutlers in Sheffield. It is large enough to fit the pocket of none but a giant, and contains 75 blades, which close up like those of an ordinary knife. Each of the larger blades is elaborately engraved, and among the subjects of these strange pictures are views of Sheffield, the city of York, Windsor Castle, Arundel Castle and a score of other famous scenes. The hafts are of mother-of-pearl, carved with great skill.

The knife is valued at $5,000.

A cooking pot is the first iron casting ever made in the territory which now constitutes the United States. It was made at a small blast furnace near Lynn, Mass., in 1642. The furnace used charcoal for fuel, had bog ore and used oyster shells as flux.

Gases from thousands of coke ovens pass off into the air and are wasted in the Connellsville coke region in Pennsylvania. These gases might be utilized, at a profit, for operating gas engines and generating electric power.

One Million a Year For Naval Gun Practice

It Costs $500 Every Time a 13-Inch Cannon is Fired--Expense to Greatly Increase

Every time one of the big 13-inch guns on the American warships is fired it costs $500. Four times a year the men are exercised in big gun practice with regulation charges, each man of the gun's crew firing four shots at these trials. There are seven men in a gun's crew on these trials. Now if you multiply seven by four, and by four again, then multiply by the number of 13-inch guns in the navy and take into consideration that every two shots cost $1,000, it is not difficult to see how fast the big guns burn up money. But the number of these largest guns is not a tithe to the 8 and 6-inch guns, in addition to the 5-inch, the 4-inch, the 6-pounders and the 1-pounders, whose number is legion and on which the practice is just as important and assiduous as on the big ones. Of course the cost of firing one of the smaller guns one time is much less, but the total cost of the practice with them is much larger because there are so many more of them to fire; so much greater practice is given with them, and they are fired so much oftener than the large guns. To fire a 4-inch common shell costs $17; a 6-pounder, $3.86; a 1-pounder, $1.14. Every ship has a battery of Colt automatic machine guns which fire cartridges in a stream fed from a belt at the rate of 400 a minute. Four times a year each man fires two belts on one of these guns. It takes a little over two minutes and it costs about $7.00 a belt.

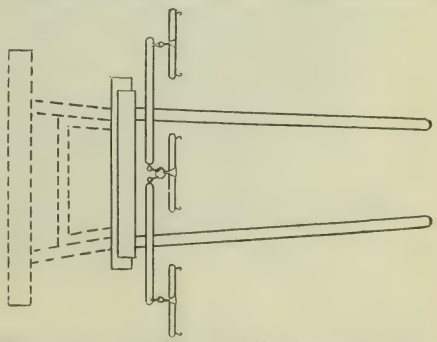
The total amount that Uncle Sam is asked to appropriate for naval target practice for the ensuing year is $1,336,000. This seems an astonishing sum to spend merely for exploding powder, but it is necessary to train the gunners to shoot straight. And this amount is small compared to what will be required when the ships now being built are added to the navy. Then this sum will have to be more than doubled, and then the annual cost for ammunition for target practice in the navy will amount to $2,690,000.

These costs allude to the regulation gun practice with actual ammunition, which has been in vogue of late years, but recently another and important custom has been added. It is the record training for the title of gun captain, which carries with it certain honor and $2.00 a month more pay. Any man is eligible to this, be he landsman, seaman, gunner or cook, and all are expected to take part in the competition. The title implies no change of duties. The cook may be a gun captain and he must continue to cook; but the title and the $2.00 extra are eagerly sought. Moreover a good record of this sort puts a man in the way of possible promotion.

The enormous cost of firing the 13-inch guns can be appreciated when it is known that the charge of black powder required for one shot is 550 pounds; of smokeless powder, 280 pounds. The steel projectile that is fired weighs 1,100 pounds. This leaves the muzzle with an initial velocity of 2,100 feet a second and would penetrate 33½ inches of wrought iron at the time it leaves the gun. With the muzzle elevated at the proper ballistic curve, a little less than an angle of 45 degrees, this projectile would go 12 miles. It is impossible to get this elevation on a ship, however.

HITCHING THREE HORSES TO A WAGON.

A method of hitching three horses to a wagon is given in the Ohio Farmer. Two wagon poles are substituted for one, and the middle horse placed between the poles, or shafts. There are two neckyokes and a



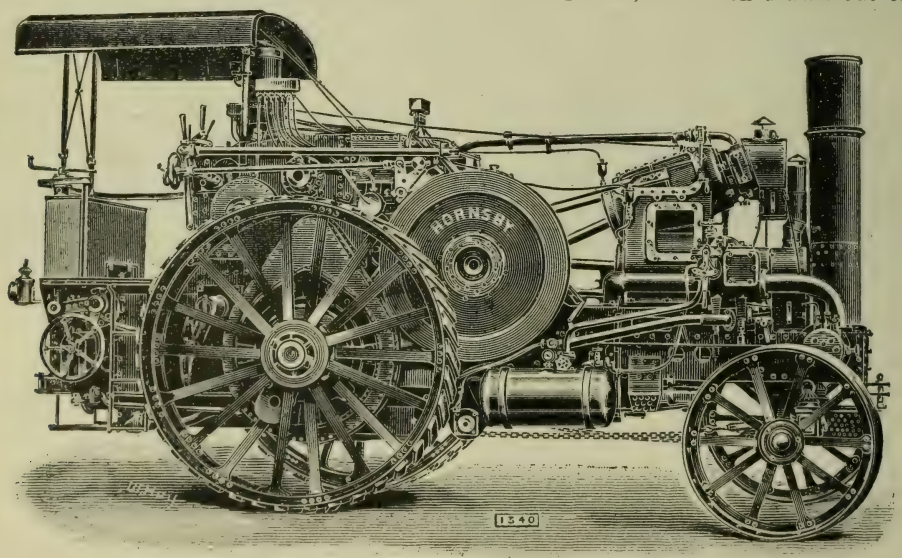
triple evener. The middle horse has one-third of each doubletree, making two-thirds of both, while each outside horse has two-thirds of the evener he is hitched to.

You are not getting all that is coming to you in this world if you do not immediately send for Popular Mechanics' Premium List. We want all our readers to get these lists because we know you will appreciate them.

ENGLISH TRACTION ENGINE WON WAR PRIZE.

A traction engine propelled by an oil engine working by natural forces, the heating of the vaporiser by means of a lamp being sufficient to start the combustion of oil vapor and compressed air, after which it works automatically, won the prize in the English War Office competition. The details of the engine are as follows:

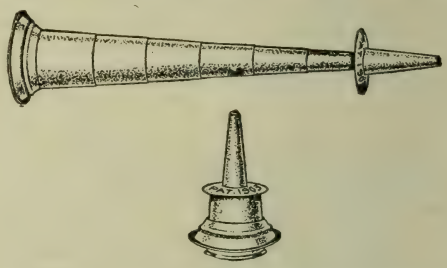
The engine has two cylinders, placed one above the other, the connecting rods being coupled up to the same crank pin, and as they work on the Otto 4-cycle principle, at alternate intervals there is an explosion given for every revolution of the crank shaft. The common crank shaft makes 350 revolutions per minute. Three oil tanks are provided with a total capacity of over 100 gallons. The oil used is refined Russian oil, but adjustments are provided so that either refined American, Scotch shale, Russian crude, Texas liquid fuel, or Burmah oils can be used. The cylinders are water-jacketed, and the water is circulated by a rotary pump round them and through a cooler, placed under the footplate, the air being drawn over the tubes by a fan. The consumption of oil fuel on good average roads in about 30 miles with the maximum load is about 350 pounds, and the consumption of water for cooling purposes for the same distance and load under one gallon. The gearing is arranged with four speeds—one and one-half, three, five, and eight miles per hour—reversing and winding gear. Every moving part and bearing has its own separate lubricator, and is supplied by a copper tube from central reservoirs. The whole of the gearing and lubricating and every movement necessary for the complete working of every function of the engine is under the control of the driver on the foot-plate.



Prize Tractor

A COLLAPSIBLE HORN.

In good season for political parades and election returns comes a new kind of horn.

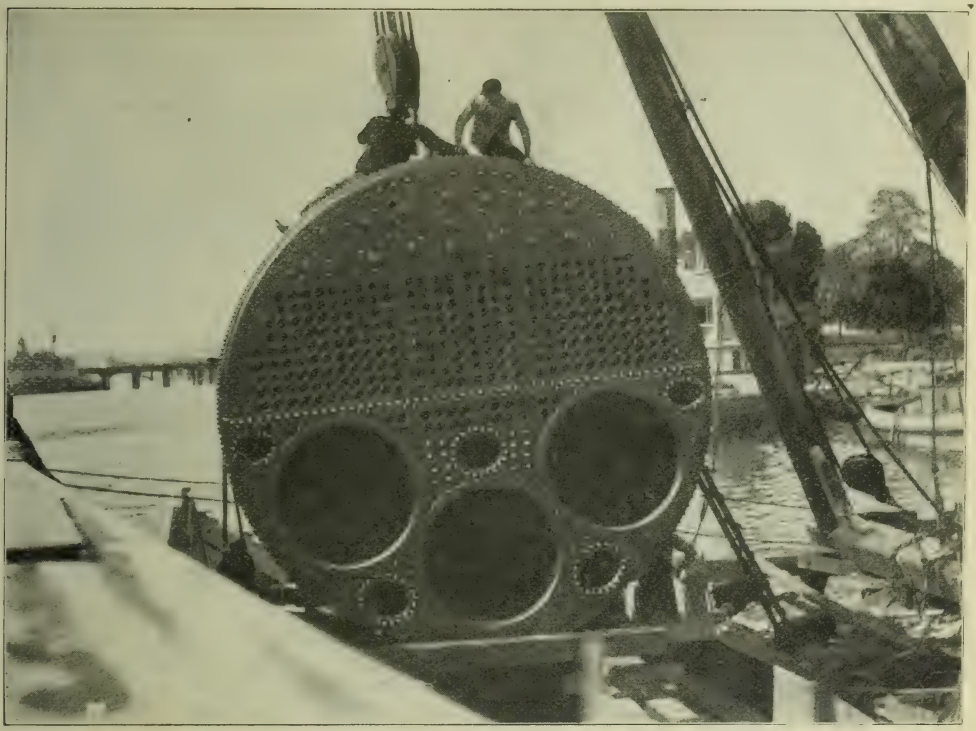


One which shuts up into small space to carry in your pocket, but when drawn out to full length is 14 inches long and produces an ear splitting blast. The illustration shows the horn extended and collapsed.

The biggest searchlight in the world, to be exhibited at the coming World's Fair, weighs nearly four tons, is of 5,250,000 candlepower and projects a beam of light seven feet in diameter.

BIG BOILERS FOR LAKE BOATS.

The steamer Santa Maria contains three of the largest boilers of their type in use on the Great Lakes. The illustration shows one of these immense steam generators being lowered into the vessel. The boiler is 14 feet in diameter and 13 feet long, containing 278 tubes each 3½ inches in diameter. The boiler carries a working pressure of 150 pounds, and weighs 50 tons.



Largest Steamer Boiler on the Great Lakes

WONDERFUL FIRE EXTINGUISHER.

A most effective fire extinguisher has lately been exhibited in Dresden, Germany, reports U. S. Consul-General Chas. L. Cole. The ingredients are as yet a secret, but the solution costs about five cents a pound. One of its best features is the fact that it will not damage fabrics. Severe tests of the extinguisher were made by saturating inflammable materials with petroleum and igniting them. A bucketful of the solution immediately extinguished the fire. Other tests such as lighting a vat of coal tar and petroleum, and firing stacks of railway ties and straw were made with the same results.

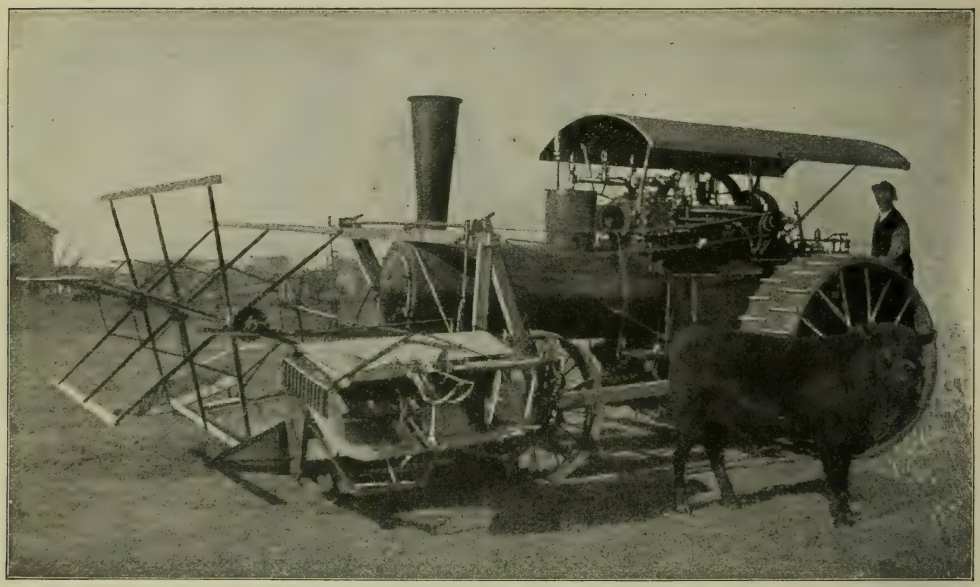
FUEL MADE FROM FLAX.

The refuse from flax straw taken after it has passed through the tow machine, conveyed automatically to the fuel machine by means of a blower, there mixed with crude oil and an artificial binder and then packed into solid blocks 8 by 10 inches in size makes a new fuel that is said to be a great heat producer and 50 per cent cheaper than coal. This fuel was tested recently on a locomotive with satisfactory results. Nine hundred pounds of the new fuel were consumed on two-thirds of the run, whereas the same distance requires one ton of coal. J. T. Smith, the inventor, expects to establish plants throughout the northwest and manufacture the product in large quantities.

SMOKELESS FUEL.

A new fuel, said to consist of coal dust and oil treated by a secret process that renders it smokeless, is to be manufactured by a French company that claims that its product is cleanly, economical and of the best heating quality.

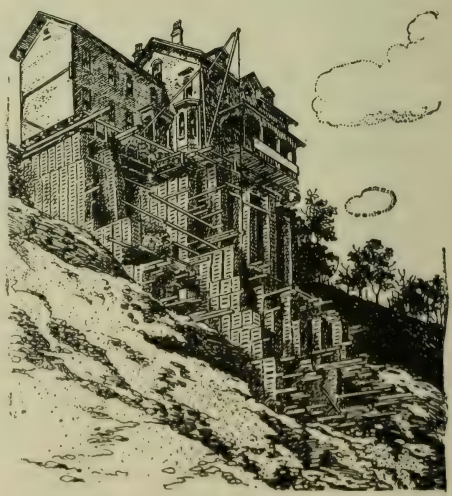
Harvests Crop and Plows Ground at the Same Time



A combined steam harvester and plow that gathers one crop while breaking the soil for the next season, is in use by Wm. Milton, at Stafford, Kansas. The same 16-horsepower traction engine that propels the binder, hauls the twelve 12-inch disk plows, and as the grain falls before the machine the dark furrows trail behind. This combination easily cuts and plows from 400 to 600 acres in a season. The Farm Implement News says it has been a great economizer of time, labor and expense, as well as affording great satisfaction in the double accomplishment of the day's work.

Raised a Brick Building 180 Feet

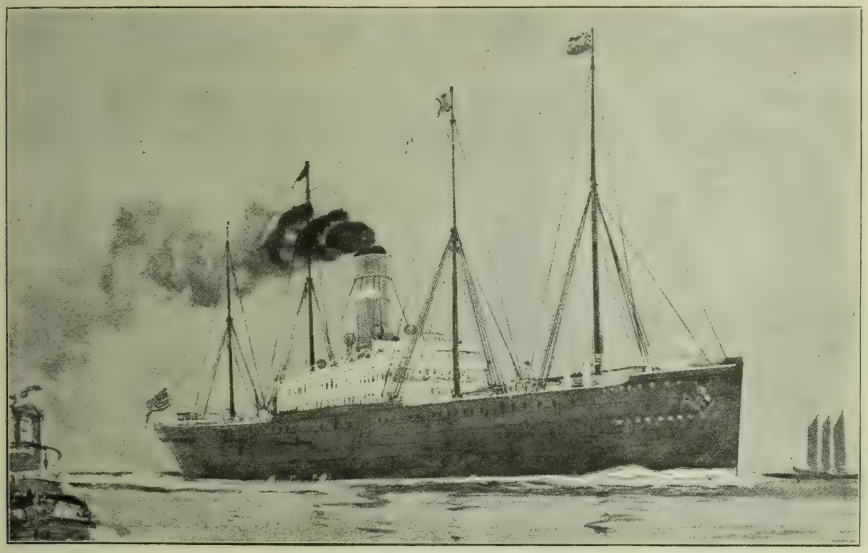
A three-story brick house weighing hundreds of tons, successfully climbed a steep bluff 160 feet high at Kansas City, without cracking a pane of glass. Upon reaching the top the house was rolled along 300 feet to its destination. It had been built some years ago in a location which was no longer desirable for residence purposes. It was a case of tearing the house down or moving it. The house was carried on a strong framework of timbers, and raised by the turning of 300 jacks divided into 30 groups of from eight to 12 each, from three to five groups being located under each sill. At a signal given by blowing a whistle, one man started at the end of each group and gave each jack in succession one-half turn. After all the groups had been turned another signal was given and the men returned to the starting points, screwing each jack another half-turn and so on back and forth, simultaneously, screwing the jacks so as to raise the building uniformly about one-half inch at each round trip.



Kansas City House-Climbing Feat

THE LARGEST AMERICAN BUILT LINER.

The largest ocean liner ever built in the United States is the Dakota, which was launched Feb. 8th at New London, Conn. The Dakota is 630 feet in length, 73 feet 6 inches in breadth and has a moulded depth



S. S. Dakota, the Largest American Steamer

from keel to upper deck of 56 feet. The displacement on her maximum draught of 36 feet 6 inches is 37,000 tons. The ship has a longitudinal bulkhead fitted its entire length, thus dividing each hold into two compartments, each having a hatch. Each hatch has two electrically operated winches and two steel built booms capable of lifting from 30 to 50 tons.

The Dakota is equipped with triple expansion twin-screw engines and 16 Niclausse water-tube boilers. Her propellers are 20 feet in diameter and maintain a speed of 14 knots at 78 revolutions per minute.

The coal bunkers are arranged above the boilers and incline at the ends so that the coal gravitates through shutes and is deposited on the firing platform. Five of the decks are of steel plating throughout.

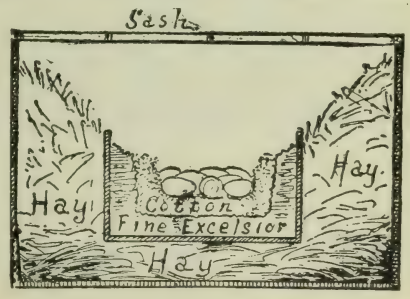
The Dakota will engage in the Pacific trade, running from Seattle by way of Honolulu to Yokohama, a distance of 5,800 miles.

The subject of steel postal cars for the protection of railway postal clerks is being agitated. Many fatalities among the clerks are due to the flimsy construction of the cars in present use.

MAKES HEN HATCH EVERY EGG.

Ideal Hen's Nest Easily Constructed With the Aid of Two Boxes

A hen's nest that will cause the hatching of every egg, if the eggs are all good and fresh when placed, is constructed by a simple process. Secure a large box and a piece of old sash for a cover. Fill half full of hay and bed a small box in the center. Line this with chaff from the hay mow. Inside this put a lining of cotton. Place nine



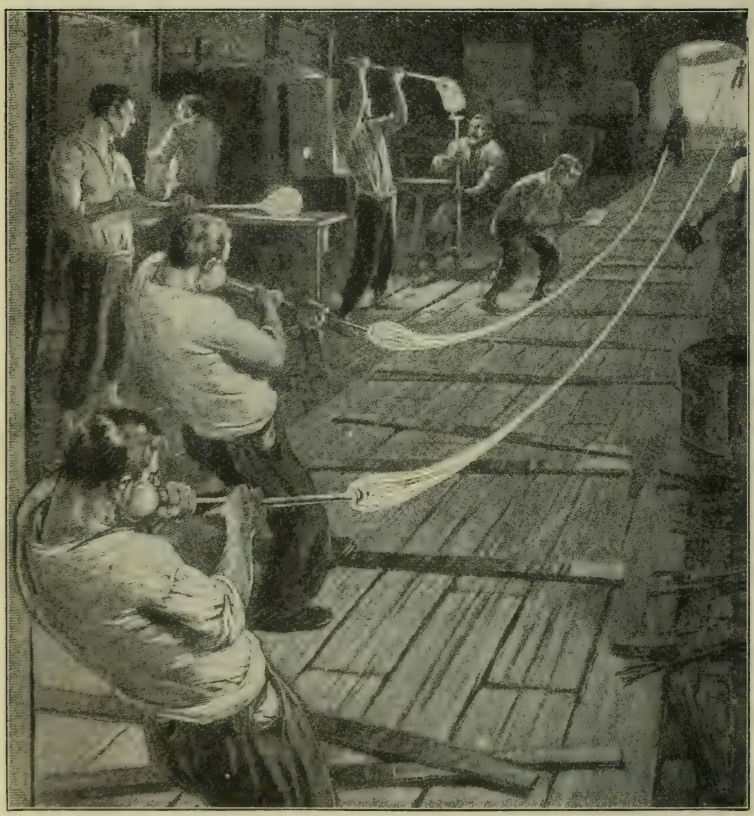
or 10 eggs on the cotton and let the hen enter on her work. The mechanical construction of the nest is illustrated in the accompanying diagram. Remove the hen each day for food and water.

"She has an automobile tongue."
"What do you mean?"
"Why, she's always running people down."

HOW THERMOMETER TUBES ARE MADE.

Few people looking at the fragile little thermometer tubes think or know anything of the process by which they are made, and yet there are few places more interesting than a glass factory.

When the raw material is brought to the factory it goes into clay pots within the crucible and remains there thirty hours at least. When it has become a molten mass it is ready for use. A long blowpipe is thrust into the vivid pool of glass, twirled a moment, and then withdrawn, bearing at its end a small glowing ball. This ball is rolled to a cone on a small slab of iron. Then it is handed to a man seated in a low wooden chair having long arms. He gives a little puff through the pipe, rolls the pipe on the arms of the chair and then it is ready for the master workmen. The blowing requires great skill and the long slender tubes stretch out between the two workers in an incredibly short time. A touch of cold iron severs the glass from the blowpipe and the finished tubes are taken to the annealing oven where they pass by gradation from the intense heat to comparative coolness.



Glassblowers Blowing Thermometer Tubes

NEW RULES FOR THE AERIAL RACES.

Several changes have been authorized regarding the regulations at the coming airship races at the St. Louis World's Fair. Entries will be received until June 1 instead of May 1, as at first announced. The prize for the highest altitude attained has been withdrawn because of the danger in such contests. The minimum speed required in the race for the grand prize of $100,000 is 18⅓ miles an hour instead of 20 miles. The exposition company will furnish free hydrogen gas for all contestants.

Thirty-four entries for the contests have already been filed. Among the contestants are M. Santos Dumont and M. Lebaudy.

The Chicago Record-Herald says: "If some one should enliven the contest by entering an aerodrome or 'flying machine' of the Langley type it would afford a spectacle eclipsing all other attractions of the exposition."

PITS FOR STORING OIL.

Oil burning locomotives are used in California and western Arizona, on the Atchison, Topeka and Santa Fe Railway. Circular pits in the ground, banked up high, the depth being two feet, and roofed over, are used for storing the oil. From these pits it is pumped into small delivery tanks and then run into the engines by gravity. The largest pits hold 50,000 barrels.

IRRIGATION CANAL THROUGH TUNNELS.

An irrigation canal which will pass through three tunnels, the longest of which is 1,400 feet, is now being cut in Nevada.

Entrance to 1,400-Foot Tunnel

The rocky character of much of the country to be traversed necessitated the tunnels.

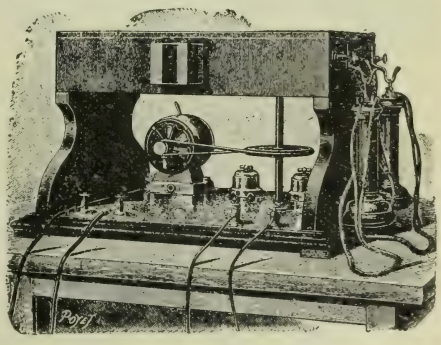
The canal is fed at its source by the Truckee river, whence it passes eastward 14 miles to Wadsworth, Nev., and thence 18 miles to the great "Carson Sink," a desert plain. The canal will be 23 feet wide at the bottom, 53 feet at the top, and 15 feet deep and will receive 1,400 cubic feet of fresh mountain water per second.

About 2,000 men are employed in this work, which will cost the Government nearly $1,000,000. The canal will open vast areas, hitherto arid and waste, to the homesteader and to agriculture, and will greatly promote industries in contingent tracts.

THE PHOTOGRAPHONE—AN ELECTRIC STENOGRAPHER.

The electric stenographer, or photographone is a recent invention that is causing great interest in Europe. The inventor is Mr. Ruhmer, of Berlin, and the first instrument was exhibited before the Industrial Congress at Copenhagen, last month.

With one of these machines attached to his telephone, one can leave his office for hours at a time and return to hear the messages received during his absence. The instrument records upon a thin band of steel the words received by the telephone. By the movement of a lever the impression on the steel band is made to yield the spoken



words, which are heard by placing the telephone receiver to the ear.

Gaffney, S. C., is the only place in the United States where tin is mined at the present time. The first shipment from the deposit amounted to 20 tons. The deposit is a continuation of one opened 15 years ago at King's Mountain, N. C., which produced high-grade cassiterite.

A SCOTTISH OIL MINE.

A peculiar industry in Scotland and one which engages much labor and capital is the mining of shale for the production of oil. Great districts are given over to this work, the large somber-looking distillation works scattered here and there emphasizing its enormity.

The shale is mined much after the manner of hard coal. After the shale is brought from the mine it passes through breakers and crushers which reduce the size of the pieces; the ground shale is then conveyed to large storage hoppers at the distillation works, whence it is fed into the retorts. Here the shale is roasted and the gas is drawn off and passed through a large condenser where ammonia and crude oil are distilled off and stored in large tanks.

Naphtha is distilled from the lighter gases after they have been drawn through the fans and have passed through scrubbers. What gas is left is used to heat the retorts. It is interesting to note that the ammonia water separated off is converted into sulphate of ammonia and commands a price of about $65 a ton.

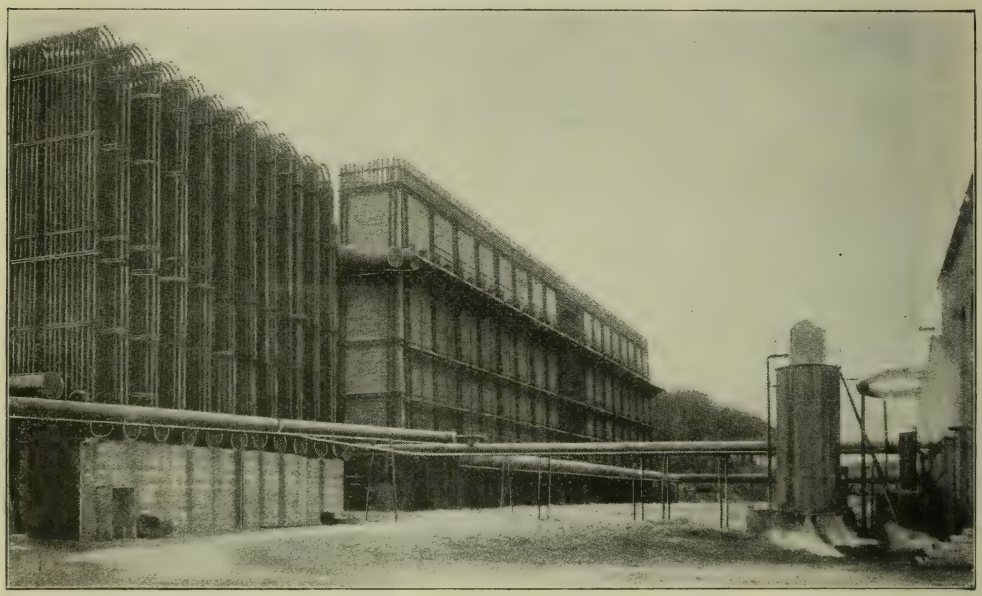
Electricity is being utilized in many of these works with a consequent diminishing of danger, reduction in coal consumption, lessening of smoke and economy of labor.

MISFIT HOSE COUPLINGS AT ROCHESTER.

When Rochester was threatened with destruction a few weeks ago a frantic appeal for help was flashed to Buffalo and other nearby cities. When assistance arrived the outside fire apparatus were for a time useless because the hose couplings which connect the fire plugs to the steamers failed to fit. Water was finally taken from the canal, but great confusion reigned while efforts were being made to connect the hose used by different cities.

The same thing happened at Baltimore, where it is related a New York fireman succeeded in tying a steamer suction pipe to a hydrant nozzle and actually drew water in this manner.

The attention of fire chiefs will now be given to securing some general standard of sizes, connections, and screw threads which will make the fire apparatus of the country interchangeable in time of great disasters. The discovery has occasioned dismay among fire insurance companies no less than among business men and property owners everywhere.



Distillation Works, Benches of Retorts and Condensers.—Powerhouse on the Right

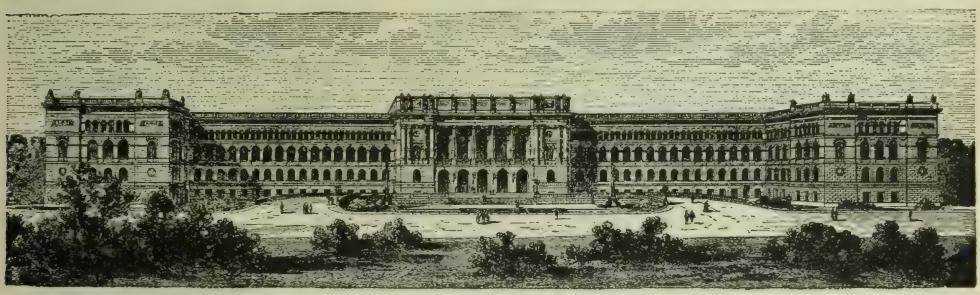
In the United States nearly 13 of every 10,000 inhabitants are studying at colleges of university status. The number in Great Britain is less than five.

Largest Technical High School in the World

The Berlin Technical High School at Charlottenburg is the largest institution of the kind in the world, having 4,378 students, all over 18 years of age. Although it is called a "high school" the work is of an university standard.

Architecturally its buildings are very beautiful, says London Technics. The main building, four stories in height, 750 feet long and 300 feet deep, presents an impressive exterior, only to be surpassed on entering the spacious entrance hall to marvel at its interior.

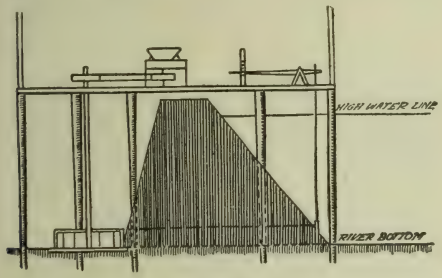
Of the five courts around which it is built, the beautiful central one, glass-covered and surrounded by galleries on every floor, is perhaps the most noteworthy. On the main floor the corridors are a series of double pillared arches and afford a fine view of the great central court or hall. All the corridors are built on the inside, thus depending on the courts for light and ventilation, while the class rooms, offices, museums, etc., are arranged on the outside. Charlottenburg is beautifully located on the main road from Berlin.



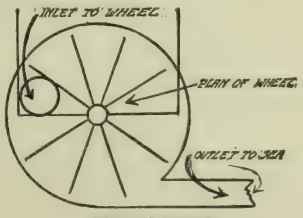
Front of Main Building, Berlin Technical High School

A CURIOUS TIDE MILL.

Vast fortunes have been lost in the attempt to perfect a tide motor which would utilize the limitless power of the flowing and ebbing tides. As long ago as 1800, however, tidal mills were in successful operation in Nova Scotia. These mills were used to grind a coarse oat meal which was generally used in place of flour at that time. The water wheel was ten feet in diameter and made of wood; the sluices were built of blocks of stone four feet long and one foot thick. The wheel was placed in a horizontal position and the shaft carried to the floor of the mill, which was about two feet above the waterline. A belt connected a pulley on the shaft to another on the spindle of the grinding stone. The mill and dam were placed at the outlet of a creek or small river, with gates swinging inward hung in the dam. When the tide ceased to flow and commenced to ebb the gates closed and retained the water. After the tide had gone out the outlet sluice was opened and the mill started. The dams were made of earth with logs embedded to give additional strength. The Canadian Engineer says: "Other mills were used for sawing logs, the reversing gear being operated by separate water wheels."



Side Elevation



Plan of Wheel

CUTTING TREES AND LOGS BY COMPRESSED AIR.

The largest tree that grows, and logs of mammoth dimensions are being swiftly cut down and sawed by means of compressed air. The advantage is that the air compressor, which is operated by a gasoline engine, is portable, being placed upon a wagon and hauled about by one team. From the compressor the air is conducted through hose to the pneumatic engines which work the saws. Compressed Air says the pneumatic engine is capable of making from 125 to 150 strokes per minute, depending on the pressure of air used. At sixty pounds pressure it will develop 2½ horse-power. The engine weighs 50 pounds, being constructed almost entirely of brass and steel tubing. It is claimed for the valve motion, which is of an entirely new design, that it has no complicated valves or parts to get out of order and that it is very simple and easy of adjustment. The frame is made of machine steel and wood and though light in weight is strong and durable.

Pneumatic Saw at Work

The makers declare that one man with one of these machines can easily cut ten cords of 2-foot wood per day, or 50,000 feet in logs, reducing the present labor expense at least 50 per cent.

The pneumatic engine shown in the illustration has a cylinder 2½ inches diameter by 30 inches long.

The compressor can be worked by steam or electric power, if available, or by an ordinary locomotive air pump attached to any logging or portable engine.

TO BUILD A BOULEVARD 1500 MILES LONG.

The famous Old Mission road of California, built and used by the Spanish mission fathers 200 years ago, is to be restored if the plans of the California Automobile Club are carried out. Inasmuch as there are several thousand auto enthusiasts in the state, including countless milionaires from the East who winter on the Pacific coast, there is not likely to be any difficulty in raising the money.

This grand boulevard, 1500 miles in length, of which the route from San Diego to San Francisco is a part, is to be made the finest roadway in the world. The natural scenery is often grand and everywhere intensely interesting. A chain of magnificent hotels is to connect the two cities.

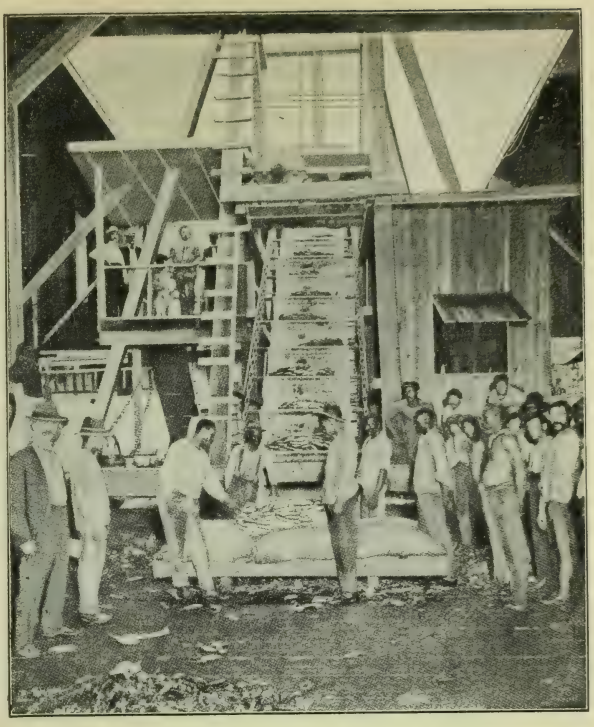
THE TECHNICAL WORLD.

To aid students and others interested in technical knowledge is the praiseworthy mission of the Technical World, a new monthly journal that has just made its appearance in the interest of the Armour Institute of Technology. The Technical World is issued in usual magazine form and contains 112 pages. Its articles are comprehensive, interesting and profusely illustrated. In the initial publication considerable space is devoted to an exhaustive illustrated description of the American School of Correspondence.

BANANAS UNLOADED BY ELECTRICITY.

Electricity is taking the place of African stevedores in the unloading of vessels. The new electrical machine which has been used so far to save labor in unloading bananas is capable of being adapted to other cargoes and undoubtedly in time will take the place of more tedious methods so out of accord with twentieth century progressiveness.

The machine, which is operated by a 15-horsepower induction motor, is built on a platform on the wharf and resembles the carrier of a threshing machine. To unload the vessel one end of the machine is lowered into the hold. The carrier runs up perpendicularly about 30 feet and across to the wharf. The wheels on the platform move on a rail track. The canvas carrier is divided by wooden bars into pockets, each 30 inches long and 48 inches wide. A bunch of bananas is placed in each pocket and the load carried to the wharf in perfect condition and at the rate of 5,000 bunches per hour.



Electrical Machine for Unloading Bananas from a Vessel

The machine is controlled from a lookout tower containing four levers.

RIDES TO FIRES IN AN AUTOMOBILE.

The chief of the Newton, Mass., fire department rides to fires in an automobile. This is one of many recent improvements making the Newton department one of the most perfectly equipped and up-to-date call forces in the United States. The use of the automobile in this line is apt to become general in all those cities where good pavements will permit, its unquestionable advantage over other vehicles as to speed and economy of motive power placing it foremost in cases where these qualities are necessary.

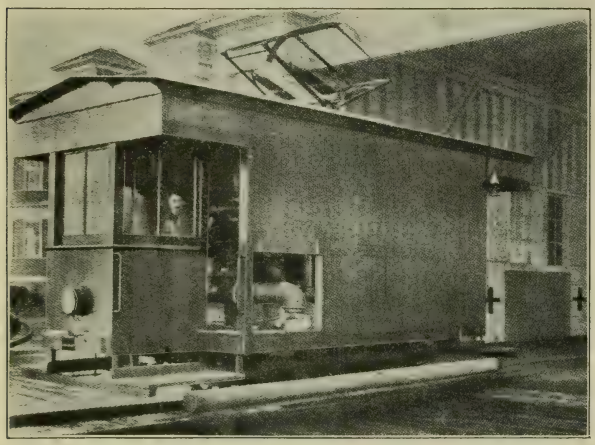
Chief of Newton, Mass., Fire Department Going to a Fire

HOW TO MAKE A BRICK FORGE.

The following is the plan for building about as nice a forge as I ever saw, says a writer in the American Blacksmith. Commence the forge as large as you want it, building it to the height of the bed just as you would any brick forge. From there on continue the forge up six or eight feet, the size of the hearth. Make an opening in front high enough to take in a wagon tire, and wide enough to give room to get the work in. There can be an opening at the back to let the work go through. Taper the forge to three bricks square and run the flue above the building, and you will never be bothered with any smoke or dust in the shop.

TROLLEY FIRE ENGINE CAR.

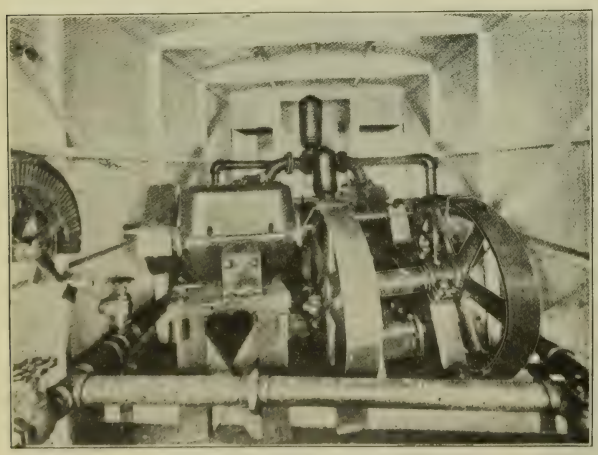
Whenever fire breaks out in any of the numerous docks, depots or other buildings of the Oakland, Cal., street railway, a strange looking trolley car may be seen



Electric Fire Car.

dashing along the street at full speed. The other trolley cars lose no time in getting on side tracks and other streets in order to let the fire car pass. This fire car is unlike any other trolley car in the world, and when its electric pumps are set in motion will throw as much water as the largest fire engine of any fire department. In order to avoid any possible delay from the trolley coming off the wire, a trolley of peculiar construction has been provided. It consists of a bar held in a frame which slides along the trolley wire instead of the usual trolley wheel. The Street Railway Journal says:

"The car is 25 feet long, and 9 feet wide, The pump room is 16 feet long. The fire pump is an 8½ by 12-inch machine, having an 8-inch suction and a 6-inch discharge. A 35-horsepower electric motor operates the pumps. A separate set of motors propel the car."



Electric Fire Pumps.

MATE, THE LATEST DRINK FOR SODA FOUNTAINS.

A new beverage, and one which promises to gain the ascendancy over other stimulating drinks is mate, a food product used for many years in South America and gradually finding its way into the United States and European countries. Experiments have shown it to possess indisputable medicinal properties with after-effects verging on a happy combination of those of opium and of bromo seltzer.

Mate is prepared from the leaves of ilex after the manner of preparing tea, and may be served in various ways.

South Americans suck it from a bowl through a silver tube termed a bombilla, says the Soda Fountain.

A Mate Pot.

Mate is a cheap product and if all claimed for it holds true it will be a lamp post for Prohibitionists to lean against.

English manufacturers are sending out a floating exhibition of English goods and manufactures for a trip around the world, taking in many great ports. An American exhibition has been proposed along the same lines and as the United States is now the greatest exporting nation of the world, nothing could be more appropriate.

Send for our Premium List.

SHOP NOTES

HOW TO COLOR ELECTRIC LAMPS.

Very often much effectiveness can be worked out in a window trim with the aid of colored lights. Colored lights are expensive. The following formula will explain how to color electric lamps, thereby saving a big part of the expense. Take a little white shellac, thin it down with alcohol, and by dipping the bulb in this it produces a splendid imitation of frosted glass when a clear white light is required. Care must be taken to have the shellac very thin, otherwise it will not run smooth. If you use green, purple, red, blue or any other color, buy a package of egg dye of the color required, dissolve it in wood alcohol and pour it into the shellac. By using this or any transparent coloring a vast number of beautiful tints can be made that will blend with your color scheme.

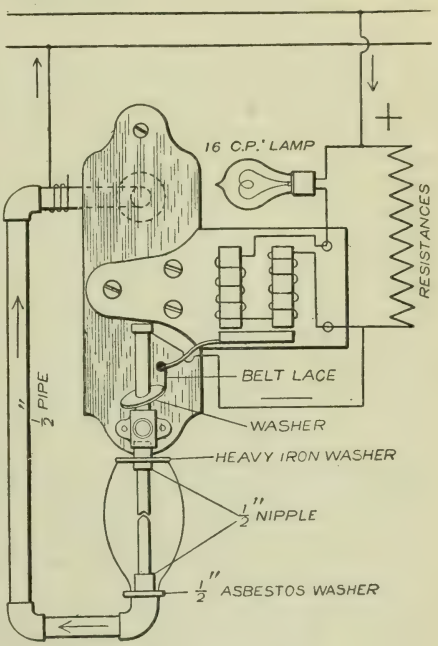
To go about it properly and to get the best results, after preparing your shellac pour it into a vessel deep enough to immerse the lamp. Take a piece of wire and fasten it around the socket of the lamp, then bring one end of wire back over the end of the lamp to opposite side of lamp to form a loop, then dip it in the solution and hang it up to drip and dry. While mixing your color bear in mind that the more dye and the less shellac the deeper the tint will be, and vice versa. Any of these colors can be removed with wood alcohol.

HOW TO MAKE AN ARC LIGHT.

Any engineer can make a cheap, serviceable arc light out of the odds and ends generally found around a plant. We get the following instructions from The Engineer:

"It will be noted in the sketch that the feed machinery is nothing more than the magnets, armature and hammer of an old electric 5-inch bell. The magnets, with a 16-candlepower incandescent lamp in series with them, are connected across a resistance of about 25 ohms, which may consist of three or four coils, taken from an old rheostat or a bank of lamps in multiple. The magnets and the 25 ohms resistance are in multiple and are connected to the positive lead, which is clamped to the top carbon. The negative lead is simply connected to the ½-inch pipe, where convenient.

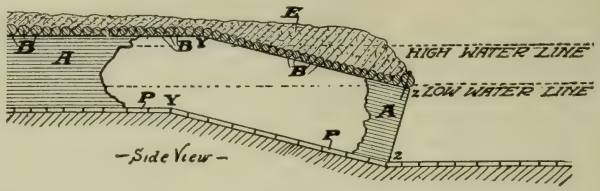
"Sliding loosely on the top carbon is an iron washer with a small hole drilled near the edge with a thin lace passed through it and tied to the end of the hammer. The spring on the armature must be bent so there will be no make-and-break action. As current passes through the magnets, the



hammer pulls on the washer, causing it to grip the carbon and lift it up, thus forming the arc. As the carbon burns away, less current passes through the magnets, causing the carbon to lower and keeping it the right distance from the lower carbon. When the hammer has lowered as far as it will go, the washer on the carbon should be low enough to strike on top of the drop tee, causing it to release its grip on the carbon and allowing the carbon to fall. More current now passes through the magnets and the carbons are pulled apart again, the iron washer having taken another grip. This action is continuous and the lamp can be adjusted, so there will be no flickering in the light whatever."

HOW TO BUILD A FROST-PROOF TAIL RACE.

Users of waterpower who have experienced trouble from freezing the past severe winter, will be interested in a method described in the American Miller which is to prevent trouble. The writer says: Our raceway has a cross-plank bottom from the



wheel pit to a short distance below the mill. The sides are planed timbers, A in sketch, covered with round cedar, B, laid crosswise and covered over with earth. We excavated the last 20-foot section from Y to Z and then carried the bottom on a level a short distance. The remainder of the waterway is open race with earth bottom.

The top of the sloping section, of course, follows the same angle downward from Y to Z as does the bottom and dips into the edge of low water, shutting off all currents of air from outside, but allowing a free flow of the water, which just flows downward under the upper covering and then rises to its original level on the outside, flowing away without having the current stopped or raising the tail water. We made this submerged section of slightly larger capacity by setting the side timbers, A, a little farther apart. But a little more space is sufficient.

Since using this arrangement our wheels have been clear of ice and frost and our drive belts are dry. Previous to this we had our main belt connections covered with frost, the gate rods were often frozen and occasionally the water wheels were solid.

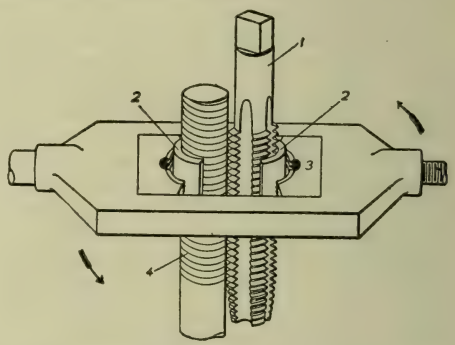
To keep the submerged portion of the tail race from floating we bolted a large log at the outer end and covered the section over with stones and gravel.

FIVE YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

A THREAD-CUTTING KINK.

Cutting a left-hand thread with a right-hand tap and die is something everyone cannot do, says a correspondent in the Engineer. Referring to the drawing, 1, is a tap which may be of any size, 2 and 2, are pieces of sheet brass or copper placed between the tap and the die and between the bar and die to prevent the crossing of the threads, and to keep the die from tearing out the threads cut by the tap. The tap is right-hand and cuts the left-hand thread. Part, 3, is the die that holds the combination of brass, tap and the iron rod in place while part, 4, is the rod on which the left-hand thread is to be cut.



It may be readily seen that, by placing the combination on the rod as shown and turning the die to the left, viz., in the direction of the arrow, after the first thread is started the rest will follow and will be found to be a perfect left-hand thread.

HOW TO CLEAN AN OIL STONE.

If the stone is glazed or gummed up, try cleaning with turpentine. If this does not restore its cutting qualities, scour it with sandstone and water, or with a piece of sandpaper fastened to a smooth board. Oil or dirt may be removed by boiling the stone in lye, or an entirely new surface may be obtained by holding the oil stone against a grindstone, revolving the grindstone and applying water at the same time.

TO CEMENT LEATHER TO IRON.

A good way to glue leather to iron is to paint the iron with a mixture of white lead and lamp black, dissolved in oil. Then cover with a cement made of the best glue soaked in water until soft, and dissolved in vinegar. This is mixed thoroughly with one-third of its bulk of white pine turpentine, and thinned with vinegar until it can be spread with a brush. It should be applied to the iron while it is hot and the leather put on and quickly pressed into place. It must be held tight by a clamp while it is drying.

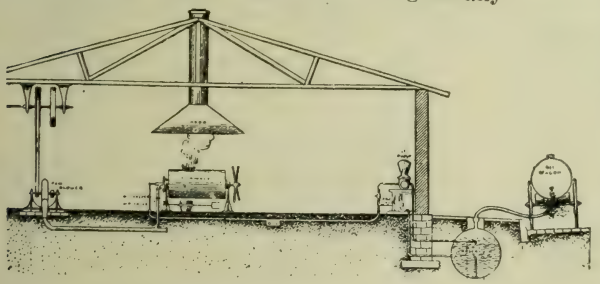
BLOWPIPE METAL WELDING.

At Birmingham, England, a special blowpipe for the seamless welding of steel, iron and other metals has been exhibited. The heat is produced by the burning of acetylene with oxygen, and is so intense that the welded joints show no trace of their welding. The separate gases pass from cylinders through valves which reduce the initial pressure in the cylinder to about 7 pounds on the blowpipe. The united gases are then ignited and though the heat zone is only about one-eighth of an inch in length it melts the metal quickly. Even quartz can be quickly melted, it is said, and blown like glass.

MELTING BRASS WITH OIL FLAME.

One to two gallons of fuel oil will melt 100 pounds of brass. This is done by means of a furnace which, to a degree, has done away with the use of crucibles.

In this furnace the oil fuel is generally



Furnace for Melting Brass

supplied to the burner by a gravity system which consists of an overhead gravity tank with a capacity of 10 to 20 gallons, to which oil is pumped by hand or power from a reservoir tank located conveniently for piping either inside or outside a building, and generally underground. When the gravity tank is placed at a height of 12 feet or more above the furnace a head pressure of five pounds to the square inch is obtained, which is ample for the oil feed. Any ordinary grade of fuel oil may be used for fuel, or, where procurable, crude oil. Natural gas may be used with the same success.

HOW TO PROTECT THE GROUND CONNECTION OF A TELEPHONE.

An excellent way to protect the ground connection of telephones is given in the American Telephone Journal.

Carry the leading-in wire down the out-

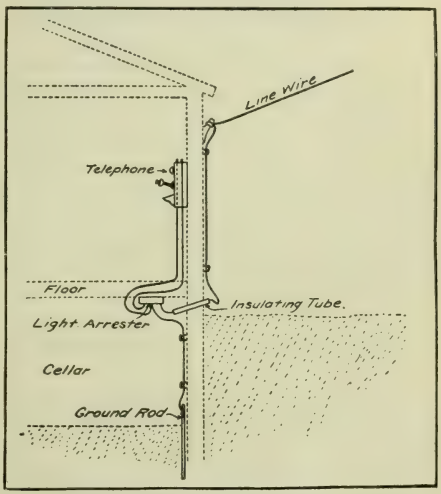
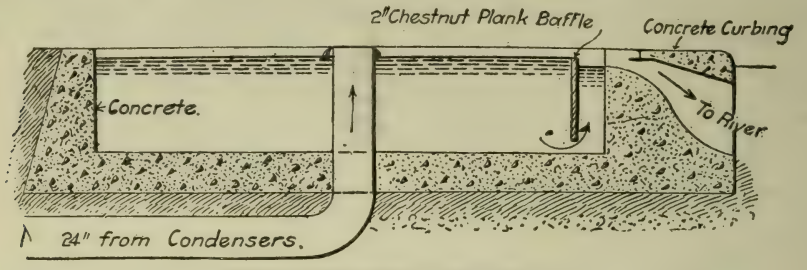


Diagram of Wires for Grounding a Circuit

side of the building and into the cellar as near as possible to the spot where the instrument is to be located; attach it to the combined fuse block and lightning arrester; run the wire up through the floor and attach it to one binding post of the instrument. From the opposite binding post run the wire down through the floor and give a scant half-inch of it a full turn about the binding screw of the arrester; carry the wire the shortest way to the ground rod, to which solder it securely. The ground rod should be not less than one-half inch in diameter and three feet in length. By this method the lightning arrester is placed away from inflammable substances and the security of the grounding connection may be easily tested at any time, besides being protected from the extremes of heat in the summer and cold and frost in winter.

RESERVOIR FOR RECOVERING CYLINDER OIL.

An ingeniously arranged concrete reservoir located outside the walls of a plant and receiving the waste water from the system within, may be used for recovering cylinder oil. The main feature is the exit of the water from the reservoir. The oil rises to the top and the water below it flows under a baffle (in order not to disturb the surface) and over a weir into the river. The oil may be skimmed off as often as the amount requires it.



Section of Reservoir for Recovering Oil.

THE WELDING OF ALUMINUM.

At a meeting of the Faraday Society, London, a paper written by Mr. S. O. Cowper-Coles stated as follows:

"Soldered aluminum joints have proven unsatisfactory, as they will not stand the test of time, because galvanic action takes place between the aluminum and solder. One of the chief difficulties encountered in soldering aluminum other than the formation of oxide, is that a few degrees below its welding point it passes into a pasty or brittle state, and, being a very good conductor of heat, the solder very rapidly cools and freezes before it has time to flow sufficiently. He then proceeded to describe Dick's machine for welding aluminum by the removal of the oxide mechanically, combined with pressure. Reference was also made to Heraeus's process of welding aluminum, which consists in heating the aluminum in a reducing atmosphere until it reaches the pasty stage, when the joint is made by kneading and hammering. Emmé's process, which is somewhat similar, consists in heating the aluminum up to 600 deg. C., and welding by hammering. The electric welding of aluminum has not proved commercially successful."

CARE IN ATTACHING BRASS VALVES.

In screwing iron pipe into a brass body-valve it is necessary to use little or no lead or pipe joint grease, as the brass is softer than iron and gives enough to form a tight joint. If lead or pipe joint grease is used it should be placed on the pipe end rather than in the valve, so that it will not be carried by steam to the bearing parts of the valve and catch and hold scale and grit on the seats and discs of the valve.

Extra long wrenches or tongs placed on the hexagon farthest from the pipe end should not be used for screwing pipe into brass valves, as this method is apt to spring the seats and place them out of line. When screwing pipe into gate and other styles of valves always close it tightly so as to make the body rigid.

PATTERN LEAD.

An alloy suitable for small metal patterns is composed of tin one part and lead one part by weight. The result is a somewhat soft alloy which requires care in the handling of the patterns. Some harder mixtures are as follows:

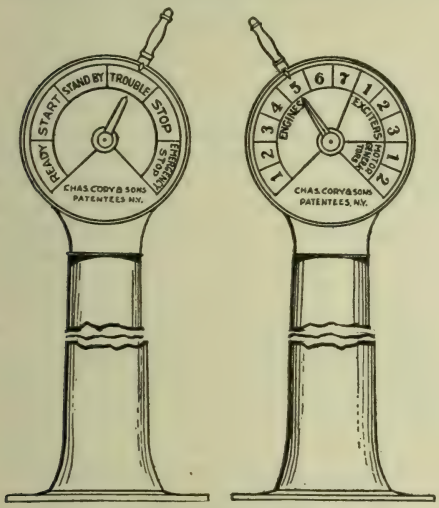
Lead.	Antimony.	Tin.
55	30	15
55	22.7	22.3
61.3	18.5	20.7

A white metal that has small shrinkage and is good for pattern plates is lead 90, antimony 10. A harder metal with small shrinkage and very good for pattern-plates is zinc 66 per cent, tin 34 per cent. The Ironmonger says an amalgam, very convenient for stopping up holes that cannot be soldered easily, is made of the filings of the above alloy, and mercury kneaded in the hand into stiff dough, squeezing out all the mercury possible. This amalgam should be pressed, when first made, into the cavity and allowed to harden. When hard it may be scraped or filed like the metal itself.

SHIP TELEGRAPH SIGNAL SYSTEM FOR POWER PLANTS.

The electric signal system generally used on board ship by which the orders are given to the engineers, has been adapted to the use of electric power plants on land. It frequently is of the utmost importance for the man in charge of the switchboard to communicate instantly to the engineer by means of signals which cannot possibly be mistaken.

The dial in the engine room bears the wording of the usual orders, and when the



Side Telegraph System

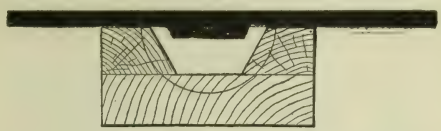
operator moves the pointer of his dial to a certain order, the pointer in the engine room instantly responds while at the same moment the bell signal also sounds. The illustration shows a pair of the sending instruments.

A POINTER ON DRILLING IN IRON.

Sometimes it is necessary to drill a hole in iron when making repairs to wood-working machines, and it is found that the drill is just a little too small for the size required. If a flat drill is used, it may be made to cut a hole larger than the width of the drill by grinding the center a little to one side, leaving the radius of one side longer than the radius of the other. If a hole is tapped for a bolt and the bolt is too tight, the threads can be opened by putting a piece of soft metal on one side of the tap and running it through again. Neither method is desirable when one has an outfit of tools, but either may help out in a pinch.

CENTER FOR SCRIBING CIRCLES.

A center to support one end of the dividers while scribing circles is made as follows: Take a piece of hardwood and set into one

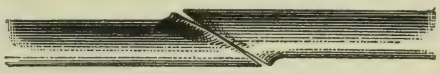


of its edges a piece of tin or other metal to receive the prick punch mark for the divider point. This is handy in working at large core boxes when scribing circles on the ends.

SCARFS FOR WELDING STEEL.

A correspondent from New Zealand who has success in welding steel tells how it is done there:

For the last six years my work has been principally working steel of various grades. I get my steel I am going to weld and upset the ends of each piece scarf them with a short scarf, seeing that my scarf is full in the center so that when they come together they will touch in the center first, so that all dirt, etc., will squeeze out sideways, as the welds come together. I then make up a good coke fire, place my two pieces of steel in it and get my helper to blow very steadily until my steel gets thoroughly heated through, and then the last few seconds I get him blowing very hard. My helper takes one piece and I take the other and give them a few light taps over the anvil to remove as much dirt as possible. I stick it first with my hand hammer, then



get my helper to give one or two light pressing blows, and then heavy and as quick as possible. I have welded from ½-inch to 2-inch steel and very rarely had to take a second heat. The flux I use is sandstone or sea beach sand, and it has always given me perfect satisfaction. I have welded steel drills for rock boring machines and hammer and drill steel, and very rarely have had one break in the weld.

I have seen men rivet steel for the rock boring machine and have noticed that they break where the rivet goes through. I think it is impossible to get a solid weld when rivets are used. I am inclosing a sketch to show how the scarfs are made.

ELECTRICAL EXPRESSIONS AND THEIR EQUIVALENTS.

The Practical Engineer publishes a table of electrical expressions and their equivalents, arranged for convenient reference, as follows:

One WATT	A RATE of doing work 1. ampere per sec. at one volt .7373 foot-pounds per second 44.238 foot-pounds per minute 2654 28 foot-pounds per hour .5027 mile-pounds per hour .00134 Horse-Power $\frac{1}{746}$ Horse-Power
One KILOWATT	A RATE of doing work 737 3 foot-pounds per second 44238. foot-pounds per minute 502.7 mile-pounds per hour 1.34 Horse-Power
One HORSE-POWER	A RATE of doing work 550. foot-pounds per second 33000. foot-pounds per minute 375. mile-pounds per hour 746 watts 746 kilowatt
One WATT-HOUR	A QUANTITY of work 2654.28 foot-pounds .508 mile-pounds 1. ampere hour per one volt .00134 Horse-Power-Hour $\frac{1}{746}$ Horse-Power-Hour
One HORSE-POWER HOUR	A QUANTITY of work 1,980,000. foot-pounds 375. mile-pounds 746. watt-hour .746 kilowatt hour
One AMPERE HOUR	A QUANTITY of current One ampere flowing for one hour, Irrespective of the voltage Watt-hour volts
TORQUE	FORCE moving in a circle A force of one pound at a radius of one foot

HOW TO WORK STEEL INTO TOOLS.

A blacksmith, successful in working steel into tools, thus describes his method in the Mining and Scientific Press: The steel is worked at an orange heat during the forging. When shaped, the next step is refining. This is done by hammering in water. A little water is put on the anvil and the face of the hammer is wetted. The steel must be at nearly red heat when this is done. The refining is repeated by reheating several times. After finishing this, the steel is heated to a dark red, so that it just shows the color, and dipped in raw linseed oil. The tool is reheated and dipped three times. The fourth time the reheat is carried to an orange color and dipped in the oil until nearly cold. The oil is then wiped off and the metal polished, care being taken not to break while polishing, as the metal is extremely hard. A large piece of iron is then heated to a red heat. The tool is laid on this with the heavy side down to draw whatever color is desired, different tools requiring different colors.

WATER PUMPED FROM GASOLINE STORAGE TANK.

Water instead of gasoline was pumped from a large gasoline storage tank at Cleveland, Ohio, recently. The tank had had gasoline emptied into it several weeks before. Investigation showed that the tank was affected by frosts and thaws, that moisture collected on the sides and bottom and the gasoline being lighter than water rose to the top, making it necessary to pump the water out first. Tanks made of galvanized iron well coated with tar will not sweat.

THE WATT.

The watt, the unit of electrical power, is 1-746 of a horsepower. It equals the mechanical energy represented by 44.24 foot pounds. One ampere of current moving under the influence of one volt pressure, or any combination of volts and amperes, and that will make unity when multiplied together, is the equivalent, in the expenditure of energy to the work a man would do in lifting one pound 44.24 feet high, or any work—any weight—raised any distance, in which the weight and the distance multiplied together make 44.24.

CORRECTING BLUE PRINTS.

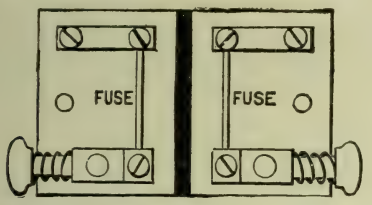
Lines omitted on a tracing can often be produced on the blue print by scratching through the blue surface with a sharp-pointed knife. If carefully done, says the American Machinist, the resulting line is much better than one made with erasing fluid.

CARE IN BURNING OIL.

In firing with petroleum, if the fire should go out, as it sometimes does when water is mixed with it, the oil continues to spray onto the hot furnace, generating a gas. If you attempt to light the fire the gas will explode with violence, says the Mining and Scientific Press. First shut off the flow of oil, then blow the gas up the smokestack, then you can light the fire with safety. Never venture near a barrel or other vessel which has the petroleum in it, with a naked light, as it is liable to have gas in it, and is more dangerous than when full of petroleum.

CONVENIENT CONNECTOR FOR TESTING.

A very simple and convenient connection for testing wires is illustrated in the London Electrical Review. It is intended for use on currents up to 10 amperes, and is easily constructed.



The square plunger is kept out a certain distance by a spring, and on pressing the ebonite knob, the two holes come into line. By inserting the wire and releasing the knob, the spring causes a fair grip of the wire. The edges of the holes being well rounded, quite small wires can be clamped without being cut. A pair of fuses protect the terminals.

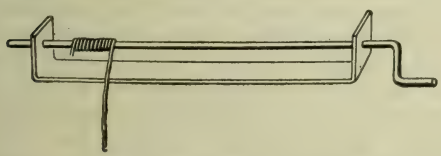
TO CUT ENDS OF STEEL TIRES.

I have a simple way of cutting off ends of steel tires, or any iron, with the aid of a helper, writes J. L. Painter in the American Blacksmith. I take a heavy three-cornered file and break it up into 2 or 3-inch lengths, and draw the temper, when they are ready to use. I lay the file on the anvil and place the tire on top and have the helper strike, after which I turn the tire, give it another blow and off it comes.

SIMPLE DEVICE FOR MAKING COIL SPRINGS.

A contributor to the American Artisan tells of a simple device for making coil springs:

"Take a piece of band iron about 12



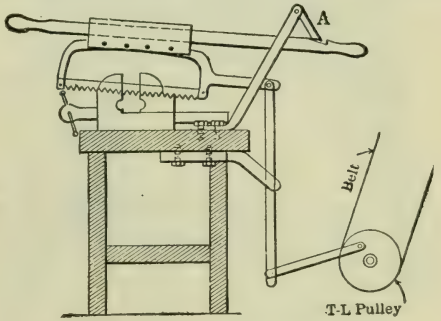
inches, 1 inch wide and ⅛ inch thick, turn up the ends as shown in the sketch, bore holes for the crank and bore holes in the end of the crank to receive the end of the spring wire. It can be fastened to the bench with screws or held firm in the vise."

HOW TO MEASURE COAL IN A BIN OR BOX.

A solid cubic foot of anthracite coal weighs about 93 pounds. When broken for use it weighs about 54 pounds. Bituminous coal, when broken up for use, weighs about 50 pounds. The consequent rule for the approximate measurement of coal in a bin or box is to multiply the length in feet by the height in feet, and again by the breadth in feet, and this result by 54 for anthracite coal, or by 50 for bituminous coal. The result will equal the number of pounds; and to find the number of tons, divide by 2,000.

A HOME-MADE POWER HACKSAW.

I send a sketch of a home-made power hacksaw; it is not very pretty, but it gets there just the same, writes a correspondent to the American Machinist. There is not much machine work about it, as can be seen. It is secured to an ordinary machinist's bench and all the parts are made



HOME-MADE POWER HACKSAW.

from stock wrought iron, with the exception of the slide which is brass, riveted to the blade frame. For holding the work an ordinary vise is used. The saw is not automatic, but a simple stop at A prevents the saw dropping after cutting through the work. When the apprentice has nothing to do, this is a good thing for practice.

REMEDY FOR VITRIOL BURNS.

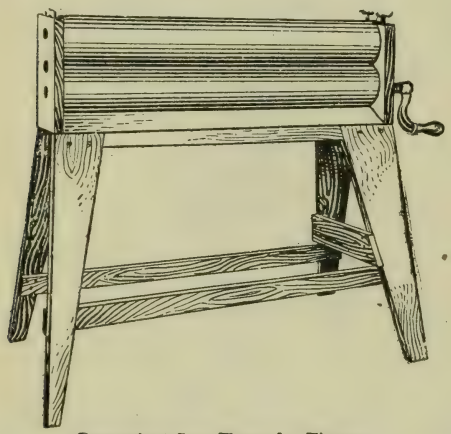
A Frenchman has discovered a remedy instantaneous in its effects for the horrible burns caused by the use of oil of vitriol. It is soft paste of calcined magnesia and water, with which the parts burned are covered to the thickness of an inch. It alleviates the pain almost immediately, and when the paste is removed no scar remains.

TO MEASURE TAPERING LOG.

As to the number of board feet in a stick of timber four by four inches at one end and eight by eight inches at the other, the stick being 24 feet long, there are two ways of arriving at a correct answer, says Mining and Scientific Press. Add the areas of the two ends to four times the area of the center section and multiply by one-sixth of the length; or, multiply the areas of the ends and extract the square root; to this add the areas of the two ends, and multiply by one-third of the length. The answer by either process is 74⅔ feet.

A SAW HORSE FOR TINNERS.

"The 'tinner's saw horse' is a model of convenience." It is made by fastening the rolls, folders, etc., to a wooden horse, like those of the carpenter's saw horse. The top and back of the horse should be as



Convenient Saw Horse for Tinners

wide as the base of the machine, and the legs made of 2 by 6 timbers, tapering toward the bottom. The inventor claims that they are convenient to approach with large and odd-shaped work; when wanted they can be brought out into a convenient place, and when not in use may be set aside in a corner or other small space.

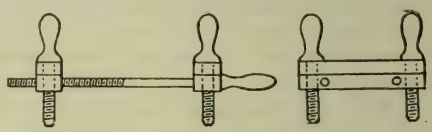
TREATMENT OF BURNS FROM HOT WATER OR STEAM.

When a man is burned with hot water or steam of course the first thing to do is to send for medical assistance, but in the interim the injured man's clothing should be removed, and bandages soaked with sweet oil and lime water should be lightly applied to the burned parts. If steam has been inhaled, sweet oil should also be swallowed by the patient in considerable quantity, as it will soothe such of the burned parts as it can reach.

Sweet oil and lime water should be kept about every steam plant, to provide for contingencies of this sort. Cooking soda (saleratus) is also very soothing when applied to burns, and castor oil in moderate quantity may be given internally in the place of sweet oil.

HANDY BELT CLAMP.

A wooden belt clamp can be made by anyone having a wood screw box and tap. It is very handy in splicing new belts, and old ones can be mended without removal from the pulleys. The writer says: "An



8-inch belt is about the limit of its use, although if you have 1⅛-inch good hickory screws, and leave the handles flat, you can turn them up with a wrench for a pretty stiff pull. I have two clamps, one for wide belts and the other for narrow, with screws long enough so that I can make a glue splice between the jaws when desirable."

TO CLEAN SPONGES.

To clean old sponges, boil them for three or four hours in water (enough to cover them) containing a couple of tablespoonfuls of carbonate of soda, or in water mixed with a couple of handfuls of wood ash, this to remove all the greasy matter that the sponges may contain; then rinse them thoroughly, squeezing them well in several lots of clean cold water. After this preliminary operation soak the sponges in chloride acid, mixed with four times the quantity of water, suiting the whole amount to the size of the sponge, but keeping the same proportions. After 24 hours let water run on to the sponge for some time, then rinse with the hands until the smell of the acid has disappeared. Hang the sponges up to dry over a hot stove, and when this has been satisfactorily accomplished, the sponge will be almost as good as new.

NEW GOVERNMENT SUCTION DREDGES.

Suction dredges, that suck up the mud and debris from the bottom of the river or harbor and deposit it in immense bins, are to be placed in service in different waters of the country by the United States government. Ten such dredges are now being built. Two will be sent to the Great Lakes; two to the Mississippi river; two to Charleston, S. C.; one to Galveston, and one to Savannah, Ga.

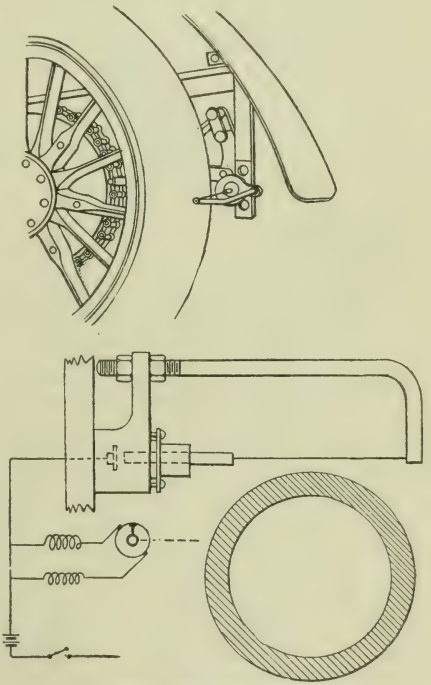
These dredges are the largest in capacity ever built and are designed in each case for the special work. They are self-propelling, sea-going dredges and do not depend upon the assistance of tugboats or other craft to move them around. When the bins in which the dredged material is deposited are full the vessel propels herself out to deep water, dumps the sand or mud and steams back to repeat the operation. Some of the dredges are arranged for depositing the dredged material into large scows fastened alongside the vessel.

The operation of the suction dredges is very interesting. A long flexible tube 12 to 15 inches in diameter drops down from the side of the vessel 20 or 30 feet or more to the bottom of the river or harbor upon which the dredging operation is being performed. The upper end of this tube is connected to an immense rotative centrifugal pump revolving at several hundred revolutions per minute and capable of handling many hundreds of tons of water per hour. The lower end of the tube is manipulated from the vessel against the sand bars and mud banks and as the water is sucked upwards by the centrifugal pumps a very large proportion of sand and mud goes with it. The centrifugal pumps discharge this water with its suspended material into the tanks on board the vessel or into scows, where the heavy matter quickly settles to the bottom, the water flowing back into the sea.

The mechanical equipment of the dredges for salt-water service will include surface condenser outfits. The dredges for the Great Lakes are provided with very large cross-compound, double-acting, air pumps and jet condensers with the usual complement of vertical duplex feed pumps, fire pumps, etc. The air pumps are of a very novel arrangement, inasmuch as it is possible by the manipulation of valves and cocks provided for the purpose to cut each pump in half and run one side entirely independent of the other side. This practically provides a spare pump in each installation without the necessity of being overweighted with two duplicate machines, and at the same time secures the advantages of compound steam cylinders.

ELECTRIC PUNCTURE PREVENTER FOR AUTOS.

When equipped with a recent English invention, an automobile is stopped the moment a nail or other sharp object is picked up by one of the wheels. Inasmuch as a tire is seldom punctured with one revolution of the wheel the device is calculated to prevent accidents of this kind. A fine wire is placed close to each wheel in such a way



Electric Puncture Detector

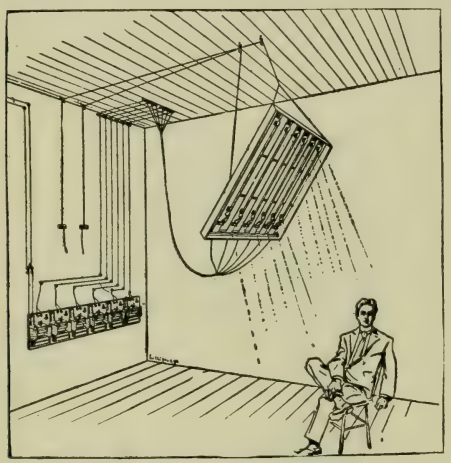
that the moment the obstacle is picked up, says the Motor Age, the wire is broken, which releases a plunger and thus in turn cuts out the current supplying the sparking device when of course the machine stops automatically.

The total power generated and used by the St. Louis world's fair will be in the neighborhood of 50,000 horse power. Over 80 per cent of the electric energy will be in 6,600-volt, three-phase, 25-cycle current.

PHOTOGRAPHER ABANDONS SUNLIGHT.

It is not so very many years ago that photographers turned customers away on cloudy days, telling them it was impossible to secure a good picture. Now one of the leading photographers in New York city has abandoned sunlight, or at least the kind which prevails in a large city, and has shut it out of his establishment entirely and put in a system of his own by which he takes better pictures at midnight than he formerly was able to do at noonday.

The use of the flash light, and electric light in taking photographs is by no means



New Photographing Light

new, but the one is used only for emergency work where the exposure must necessarily be short and natural light impossible; such as a large banquet party for instance. Very fair work has been secured with arc and incandescent electric lights, and engravers who use the photographic process now work entirely with electric arc lights instead of sunlight. Such has been the progress in the art that the exposure of one one-hundredth of a second on a cloudy day, or a thousandth part of a second on a bright day will produce with quick-acting plates excellent results; while pictures taken, developed and printed, all at night, absolutely sun-less photographs, are common.

But all these possibilities have heretofore lacked the necessities for artistic lighting. The flash lights often make people look like lunatics, and the electric light effects have been mechanical. "The new light is really an electric light," says Photo Beacon, "working through the fusing agency of mercury—a form of Crooke's tube."

The inventor says: "I am enthusiastic about it and believe that nothing which has been discovered since the advent of the dry plate, twenty-five years ago, will so revolutionize photography, especially portrait photography, as will this light. It is an epoch-maker."

FUEL ALCOHOL FOR AMERICA.

Proposed Law That Would Be of Wonderful Advantage in Our Commerce

At last America has awakened to the importance of ethyl alcohol for manufacturing purposes, and Congressman Henry S. Boutell of Illinois has introduced a bill in Congress providing for the manufacture and sale of the alcohol free of tax. Germany has found denaturized alcohol a strong commercial competitor of coal, and it has entered conspicuously into all the manufacturing industries of that country. Recently an alcohol exhibition was given at Berlin (reported in a previous issue of Popular Mechanics) at which the numerous and varied uses of the fuel were demonstrated. In propelling light vehicles and running small engines the alcohol has been found superior to any other fuel. It is used for cleaning, cooking, heating, lighting and numerous other purposes to wonderful advantage. In 1902 Germany produced and consumed 58,632,840 gallons of untaxed denaturized alcohol. The use of this fuel has enabled Germany to successfully compete with the United States in many industries previously controlled by this country. Germany's success with the fuel long since caused England and France to emulate her example, and if the Boutell bill is passed the United States will be given an equal chance in the race for the world's commerce, and a new and important industry will furnish a new source of heat and power for many manufactories and various industrial, amusement and domestic purposes.

DEAD SEA'S ONLY BOAT.

Navigation on the Dead Sea is neither extended nor remunerative. There is just one boat there and that is a little sail boat 20 feet long. When adverse winds blow the sea is lashed into indescribable fury. The authorities will not consent to a steam tug being put on the sea, although there would then be considerable traffic, which now goes around the sea on pack trains.

LIGHTING SYSTEM

FREE TRIAL TO MERCHANTS

We will ship merchants a Two-Light Outfit on two weeks' FREE trial. If not the best thing you ever saw, return it at our expense. Two-Light Ornamental Chandelier Outfit complete, with two-gallon Tank and 25 feet of hollow wire, **$9.** You can afterwards add any number of lamps, which are $3.35 each. Extra hollow wire 3c. per foot. Burned under 6 pounds' pressure, with an ordinary gas mantle, it produces 500 candle power light. Best and cheapest system on the market. Absolutely safe. Reduce your light bills. This offer 60 days only. Order today, sending diagram.

STANDARD GAS LAMP CO., 141 Ontario St., CHICAGO

"Magic" Search Light (like cut)	$2.00
Vest-Pocket Light	1.50
Telephone, complete	2.50
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	90c. and up
Battery Motors	75c. to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Library Lamps	3.00
Electric Carriage Lamps	5.00
Electric Reading Lamps	5 00
Miniature Electric Railways	3.25
Electric Scarf-Pins	1.50

Our Free Catalog

describes many other electric novelties. We promptly refund money if dissatisfied.

AGENTS WANTED

These novelties sell on sight and are easily shown. Everybody is interested in some of them. We want good, live, responsible agents in every place, big or small, and there's an interesting proposition ready. All particulars for a postal.

J. W. SCRIBNER & CO., 161 Niagara St., Tonawanda, N.Y.

The World's Headquarters for

ELECTRIC NOVELTIES AND SUPPLIES

If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3.00
Battery Hanging Lamp	10.00
Telephone, complete, $2.50,	5.95
Electric Door Bells	1.00
Electric Carriage Lamps	5.00
Hylo Turn-Down Lamps	.60
$8 Medical Batteries	3.95
$12 Belt, with Suspensary	2.50
Telegraph Outfits	2.25
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights	3.00
Electric Railway	2.75
Pocket Flash Lights	1.50
Necktie Lights 75 cents to	3.00

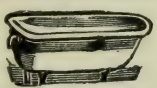
SEND FOR FREE BOOK

$3 Electric Hand Lantern **Agents Wanted**

OHIO ELECTRIC WORKS . . . Cleveland, Ohio

Plumbing Supplies

1-3 Saved by trading on our wholesale prices. Full line in stock. Quality guaranteed. Shipments prompt. *Send for free illustrated catalog.*



B. P. KAROL, *231-235 W. Harrison St.* ***Chicago, Ill.***

J. W. Middleton & Co.

PUBLISHERS OF

THE INTER-STATE CORPORATION RECORD

Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing

165-167 Dearborn St. Chicago

BOOK REVIEWS.

MY AIR-SHIPS, by Alberto Santos-Dumont. 12mo, 400 pages; 75 illustrations. The Century Co., New York. Price, $1.40. This book tells in an entertaining manner of the Brazilian aeronaut's many daring ascents and descents, of accidents and successes. His airships seem to assume personalities and one follows them with increasing interest. One chapter discusses the possibilities of the air-ship in war. Seventy-five photographs and diagrams and a most appropriate cover design add much to the book.

ENGINEER'S ARITHMETIC, by Fred H. Colvin and Walter Lee Sheney. Pocket size, 125 pages. The Derry-Collard Co., New York. Price, 50 cents. This book is not intended as a complete guide to engineering, but to give the foundation principles of such calculations as an engineer is likely to need. It gives a number of valuable tables and a glossary of terms, also rules for horsepower, boilers, etc. It is written in the simplest manner and may be easily understood, and therefore is well adapted to the needs of the stationary engineer.

COMPENDIUM OF DRAWING, compiled from the courses of the American School of Correspondence at Armour Institute of Technology, Chicago. Two volumes; 900 pages; 1,000 illustrations. Price, until June 1, $3.00 per volume; $5.00 per set. Regular price, $5.00 per volume; $8.00 per set. Part I. deals with the architectural or artistic side of the subject and covers Mechanical Drawing, Shades and Shadows, Perspective Drawing, Pen and Ink Rendering and Architectural Lettering. Part II. deals with the mechanical or practical side and includes Working Drawings, Mechanism, Machine Design, Sheet Metal Pattern Drafting, and Tinsmithing. Each section is followed by the Examination Questions of the American School of Correspondence. The great value of this work is in its clear treatment of each section, its many illustrations supplementing the text. The section on shades and shadows brings the contrasting methods clearly before the eye and enables the reader to locate his own faults in this line. While the first volume attracts more interest the second is more valuable for general use and practical purposes.

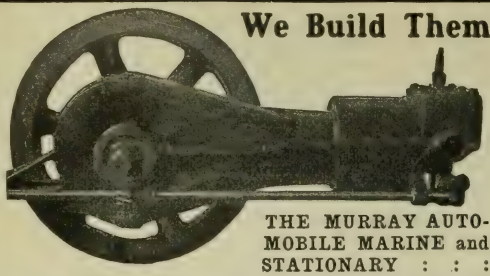
Steam and Electrical Engineering, by E. Spangenberg, M. E., Albert Uhl, A. I. E. E., and E. W. Pratt. 672 pages; 648 illustrations. Geo. A. Zeller, St. Louis, Mo. Price, $3.50. This book is designed to cover the ground of Steam and Electrical Engineering completely, and in a manner making it valuable either as a reference or text book. It contains 1,035 questions and answers.

P. M. POPULAR.

"Popular Mechanics is still popular as you will see by the following list of 14 yearly subscribtions which I obtained in a few hours," writes Sydney J. Staple of Lead, South Dakota.

HOW TO KILL GERMS IN CLAMS.

Clams are a nutritious food, but it has lately been demonstrated that they contain typhus bacilli, which make them highly dangerous unless they are properly steamed. If three layers of them are cooked by steam, the lower layer should be steamed 10 minutes and each of the two upper layers 15 minutes. This kills the bacteria and is the best way to prepare the clams.



We Build Them

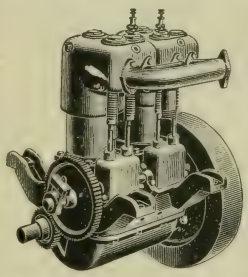
THE MURRAY AUTOMOBILE MARINE and STATIONARY : : :

GASOLINE ENGINES

Transmission, Gears, Carburetters, Pumps, Mufflers, Etc.
Write for Circular and Prices before ordering.

W. B. MURRAY, 1253 Milwaukee Ave., Chicago

DOUBLE CYLINDER

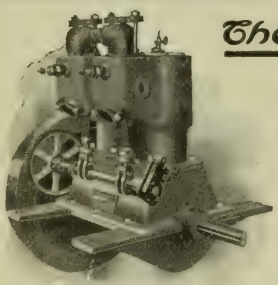


Gasoline MOTORS

4½ BORE. 5½ STROKE
12 H. P.
Simple—Reliable.

Write us for full particulars and prices

JACKSON MOTOR CO. 43 N. Union St., Chicago



***The* Hoffman Motors**

ANY HORSE POWER for AUTOMOBILE or MARINE

Write for CATALOG and PRICES

H. L. HOFFMAN MOTOR CO.
28 West Randolph Street, Chicago

Insure Your Motors

BY USING

PEERLESS COMMUTATOR COMPOUND

No Grease — No Oil — No Graphite — No Tallow

DOES NOT GUM

Send One Dollar Trial Order.
Distributing Agents Wanted.

Peerless Manufacturing Co., : : New Orleans, La.

MARCHING THROUGH KOREA.

Smite the drumskys, boyseroff, we'll have another song!
Sing it as we used to singsky fifty thousand strong!
Sing with a spiritsky to start the world along.
While we go marching through Korea!

Hurrahsky! Hurrahsky! Behold our fighting vansky!
Tigeroff! Tigeroff! Watch us smash Japansky.
We will prove that the Czar's a nifty little mansky,
While we go marching through Korea!

Watch old Ivan Blowski as he sounds the bugle call,
Turn the picture of Japan aroundsky to the wall;
Let no Japanese escape, but shooteroff them all,
While we go marching through Korea!

Hurrahsky! Hurrahsky! We prithee watch our smosky!
Tigeroff! Tigeroff! If we let one blokesky
Get away alive and safe I only hope we chokesky.
While we go marching through Korea!

—Milwaukee Sentinel.

PRAISE FROM SAN FRANCISCO.

The San Francisco Examiner says: "The current number of Popular Mechanics, perhaps the most progressive and interesting publication of mechanical and inventive progress in America, explains for the first time the mechanism of the electric Post, the most interesting system of rapid transit letters and parcels by electricity."

FREE WHARFAGE AT ST. LOUIS.

Yachts launches and houseboats have been granted free wharfage space along the river front during the World's Fair by Joseph P. Whyte, harbor and wharf commissioner, acting for the city of St. Louis. The concession lasts during the seven months of the exposition. The circular reads, in part, as follows:

"Yachts and steam launches.—Yachts, steam launches and all boats propelled by their own power will be assigned wharf space between Chouteau avenue on the south and Biddle street on the north. No charge will be made for wharfage.

"Houseboats.—Houseboats will be assigned wharf space north of Biddle street and also south of Chouteau avenue. No charge will be made for wharfage.

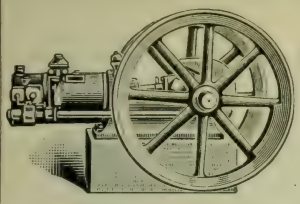
"Applications for Wharf Space.—Application for wharf space should be made to Joseph P. Whyte, harbor and wharf commissioner, city hall, St. Louis.

"Telephone Service.—Free telephone service will be furnished to visitors at the harbor office, foot of Market street."

Boat clubs of St. Paul, Minneapolis, Winona and other up-river cities have projected trips to St. Louis by water. A number expect to use their vessels as hotels during their stay.

MARRIED BY NINE DRINKS.

A peculiar wedding ceremony took place at Berkeley, Cal., recently, between a maiden just over from Japan and Sakio Makino, proprietor of the Dwight Way Belle Nursery. The bride and groom were each ushered into separate darkened rooms where each drank three cups of wine three times, thus becoming, after the Japanese custom, man and wife.



"For over **20** years we have run **OTTO** engines for motive power with great satisfaction."

So writes the Aldine Printing House, Xenia, Ohio. There is a **sermon** in this statement for every power user—present and prospective.

The **OTTO** has seen the rise and fall of many imitations. The journey of most of them from the foundry to the scrap pile has been short indeed. Why experiment with the cheap kind when the reliability of the **OTTO** is attested by over 75,000 users.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street **MINNEAPOLIS: 318 3rd Street** **OMAHA: 1108 Farnum St.**

CRANE VALVES

ESTABLISHED 1855

No. 10 Double Jet Blow Pipe
Capacity 3-4 pint. Weight 2 pounds

NEEDLE FLAME

OVER 3,000

THE TURNER DOUBLE JET ALCOHOL BLOW PIPE NO. 10

Has the nearest approach to the Oxy Hydrogen Blow Pipe Jet invented and is made so compact it can be carried in the pocket. The fuel is wood alcohol and it will run 3 hours at full blast from one filling. The flame is non-oxidizing and can be regulated from a needle point to a brush flame. Unexcelled for jeweler's and optician's work, fine brazing and soldering,

LABORATORY AND EXPERIMENTAL WORK AND LEAD BURNING

SEND FOR CIRCULAR

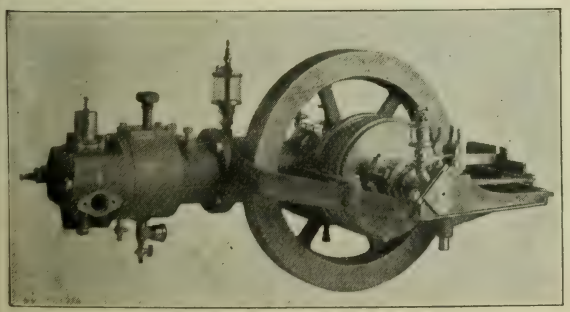
The Turner Brass Works

55 North Franklin Street, Chicago

Special Brazing Tools for All Mechanical

purposes, from 1 quart to 10-gallon capacity, from a needle point flame to a brush flame 3 inches in diameter. There is no limit to the work that may be accomplished with our tools : : : : : : :

WHITE MFG. COMPANY
205 Michigan Street, CHICAGO
WRITE FOR CATALOGUE AND DISCOUNT



ENGINES - -

Vertical and Horizontal

4 to 20 Horse-Power for

AUTOMOBILES

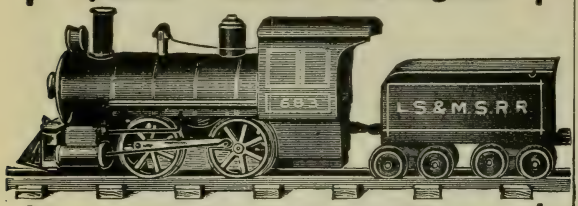
with and without Transmission

Send 3c. Stamp for Catalogue.

The Automobile Supply Co.
Successors to
THE P. J. DASEY CO.
Marine Building. **Chicago**

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



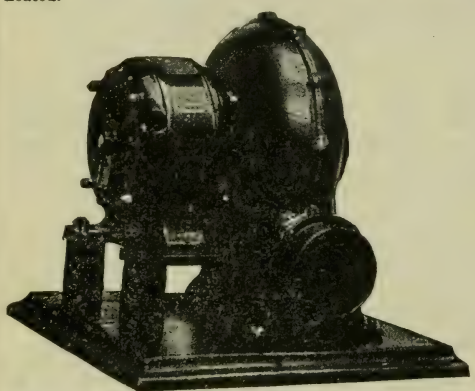
Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio

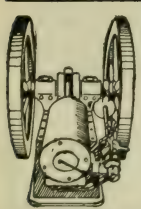
NEW ERA ELECTRIC BLOWER

Direct connected, has been designed especially for the blacksmith, and it is his ever ready helper that works for less than five cents a day, and never tires. It places him on an equal footing with the largest steam shops and allows him to work steadily at the anvil while his work is being "electrically" heated.



WRITE FOR CIRCULAR AND PARTICULARS

NEW ERA ELECTRIC CO., 942 W. Lake St., Chicago



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

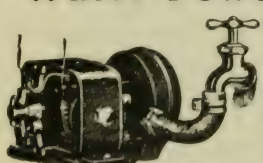
CAVANAUGH & DARLEY

25 West Randolph Street, Chicago

WE MANUFACTURE THE BEST

designed, finest constructed, most efficient type of miniature

Water Power Plants



For generating electricity at practically no expense. 3 sizes nominal capacity 25-50-75 watts. To the electrical student these outfits will furnish the most efficient instruction. Postal brings catalogue of dynamos, motors, steam and gasoline engines, novelties, water motors, etc. Write now. Don't delay. Good live agents wanted in every town.

C. S. PIPER & CO., Detroit, Mich.

MAN NAMED RAFFERTY.

(Based on a Philippine Incident.)
Man named Rafferty—Needn't laugh;
No one said the name was Greek,
French or German. Stow the chaff!
Here's the word I wish to speak:
At the ambush of Kenire
Hell broke loose, with sulph'rous glare;
All the heights were ringed with fire—
Man named Rafferty was there.

Man named Rafferty—Here the pass
Grew so narrow, rock bestrewn,
That the winds, in surging mass,
Shrieked for aye an eerie tune.
Straight ahead the demons came,
Yelling, howling, in their wont,
Till we blocked their hellish game—
Man named Rafferty in front.

Man named Rafferty—"Be me sowl,"
So he said, "jist wan man can
Howld thim divils that wud prowl
Afther blood, and—Oi'm the man.
Rin yez sphalpanes! Niver fear;
Oi wull kape thim, do yez mind."
Well, we ran, for life is dear—
Man named Rafferty behind.

Man named Rafferty—No one knows
Just how long he held the pass
'Gainst that horde of grimy foes,
Ere they crushed him, mass on mass,
But he saved us in his fall;
Loyal heart, and brave, and true—
Grace of God, surpassing all,
Man named Rafferty, for you.

—Sunset Magazine.

MIKADO JUST LIKE A MORMON.

Mutsuhito, the emperor of Japan, would be called a Mormon, if he lived in America. He has nine wives, one of whom is the empress and eight are consorts, having no social rank and not figuring in any way in the court ceremonies. They were selected for him by the imperial council from among the first families of the nation. William E. Curtis in "The Yankees of the East," says of them:

"They seem to be a sort of guaranty that there shall be an heir to the throne as their children are recognized as of full standing in the royal pedigree, and the present heir apparent is the son of one of them. They are selected because of their pure blood, their health and beauty and sometimes for political reasons, for it is considered the highest distinction that can be conferred upon a woman in Japan—to be empress is nobler only. The left handed wives of the emperor often wield a tremendous influence, for obvious reasons, and their relatives are supposed to profit thereby. They live in the greatest luxury, are surrounded by multitudes of attendants and except for their omission in the court codes of etiquette, they stand equal to the empress herself."

The book states that the emperor has had 12 children, of whom only four, three girls and one boy, are living. The Countess Sono was the mother of four children, the Countess Chigusa and the Countess Yanagiwara of three each and Mme. Hashunato and Mme. Hamuro of one child each. Woshito, the prince imperial, is the son of Countess Yanagiwara. Before her marriage the empress of Japan was Princess Haruko. She was married at 19 and is two years older than the emperor. She has had no children. The noblemen and wealthy men of Japan also have many wives each and it is considered perfectly proper to marry them from among the lowest women of the nation.

Our New **FLASH BOILER**
For 1904

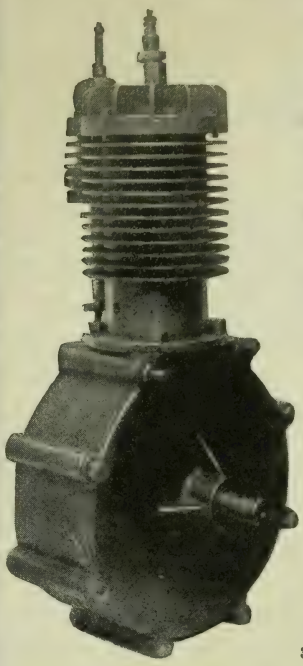
No burning of boiler—No water ass—No smoke.
Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**
Condensers, and other appliances are marvels of mechanical development.

See our exhibit at Chicago Automobile Show.

Barton Boiler Company
SOLE MANUFACTURERS,
4230 State St., Chicago, Ill., U. S. A.
WRITE FOR FULL PARTICULARS

3 Horse-Power, Air-Cooled
Bicycle ENGINE



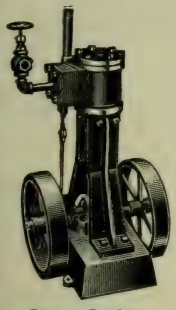
Bicycle Engine 1 to 4 cycle, Air or Water-Cooled—1¼ to 30 H. P.

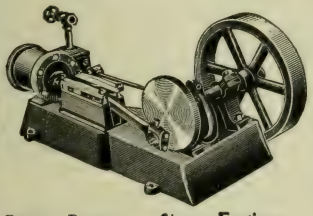
Bicycle Motors, Auto Supplies, Accessories and Castings for Bicycle Motors : : :

W. HOFFMAN MOTOR WKS.
1253 N. Halsted Street
Chicago, Ill.

Weight, 70 lbs. Bore 3-4 in. Stroke, 31-4 in

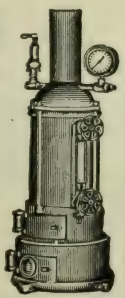
BE YOUR OWN ENGINEER
We Can Furnish You With
ENGINES
1-8 H. P. UP.

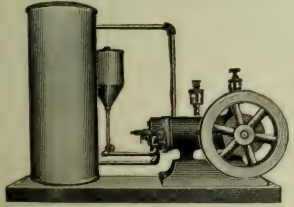




Steam Boilers, Steam Pumps, Steam Engines, Gas and Gasoline Engines

For Stationary, Marine and Automobile use. Dynamos, Motors, Electric Fans, Electric Novelties, Batteries & Supplies, Individual Electric Lighting Outfits, 8 to 100 Light. Our new Illust'd catalog sent postpaid 6c.





MARTIN MFG. CO. 180 W. Madison St., CHICAGO

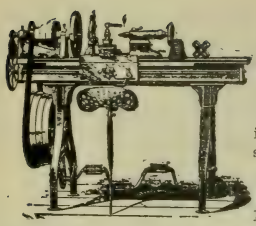
Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.
CHAS. E. GREGORY, Pres.
153 to 159 S. Clinton St.,
CHICAGO



LATHES

9 to 13 inch Swing

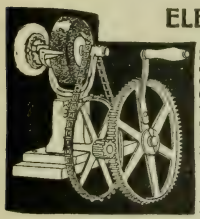
List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

The WINGET CONCRETE
BUILDING BLOCK MACHINE

Patents Guaranteed. Any Size or Shape in **Hollow** or **Solid Blocks** required in ordinary building operations can be made on one and the same machine.

A. D. MACKAY & CO.
General Sales Agents,
Chamber of Commerce, : : : CHICAGO



ELECTRIC DIAMOND GRINDER

Shipped on 10 days FREE TRIAL, 3,000 revolutions per minute. Only Hand Power Grinder with CARBORUNDUM wheels. Cuts eight times faster than emery, twenty times faster than sandstone. Will not draw temper. Try it FREE. If not satisfactory return at our expense. If satisfactory remit us $4.50.

LUTHER BROS.
Dept. P. M. North Milwaukee, Wis.

JOHN KIOLA, General Engraver
Seals, Badges, Steel and Brass Stamps,
Embossing Dies, Etc,
Drop a Postal for Free Booklet
R. 59, 155 W. MADISON STREET, CHICAGO, ILL

MARK YOUR NAME on your TOOLS, etc.

Price per letter for Steel Stamps		
SIZE OF LETTERS	INITIAL STAMP	NAME STAMP
1-16 in.	18c.	14c.
1-8 in.	18c.	14c.
3-16 in.	23c.	18c.
1-4 in.	35c.	28c.

SEALS $1.70 WITH A **Steel Stamp**

WILLIAM SCHRIDDE,
Engraver and Die Maker
35 S. Clark St. Chicago, Ill.

C. H. HANSON
MANUFACTURER OF
•MACHINE PLATES•
44 SO. CLARK ST.
CHICAGO

NAME PLATES, STEEL DIES
SEALS and STENCILS
C. H. HANSON, 44 So. Clark St.
Chicago

HOGS SKINNED INSTEAD OF SCRAPED.

Yates county, New York, has started the custom of skinning hogs and it has proved so satisfactory that the old method of scalding and scraping has been done away with nearly altogether in that county. There are no packing houses in Yates county, and the hog skinning is done by the village butchers, entirely relieving the farmer of this formerly arduous task. The butcher charges no more for the work of killing, skinning and cleaning the hog than to be permitted to retain the hog skin.

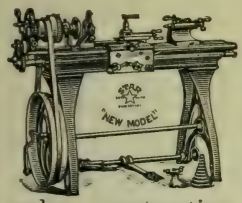
E. C. Gillett, a resident of Yates county, writes: "The practice of skinning hogs has grown and spread in this county until not more than 10 per cent of all the butchering done is by the old-fashioned way of scalding. Thirty years ago hog-skinning was practiced by only one man in this county and that on a limited scale. The demand for his services increased so that he was obliged to take a partner, and yet another, until now there are dozens of men who make it a sole business for six or seven months of the year. The butcher takes the skins for pay and they are worth from 50 cents to $1.00 each. It is remunerative business. From the standpoint of the owner of the hog it is a good thing, too. Before the advent of the skinner a big iron kettle had to be procured in which to heat the water, a hogshead or tub in which to scald the porker, a platform built on which to lay the animal while the hair was scraped off, the water carried and heated to the boiling point. These preparations took the best part of the forenoon. If the hogs were large and heavy, or there were many of them to kill, help had to be secured from a neighbor, and that meant extra meals for the good housewife to get, besides the work of cleaning the fat from the stomach and intestines, which always used to fall to woman's share of the butchering.

"Now, the butcher will drive into the yard, catch, kill, skin, clean the inwards and hang up a half dozen hogs in two or three hours. There is no water to heat, no mess to clean up, no extra help to hire and feed. The loss in weight is slight, from five to 15 pounds, according to the size of the hog, but the butcher will pay half a cent more per pound for pork skinned to cut up on the block and for home use it is decidedly better. This practice seems to be only local, for the secretary of the State Grange told me not long since, that he had traveled all over the State, but he never heard of such a thing as skinning a hog outside of Yates county. There is a good opening in every section for a butcher to take up this business. It might take a little time to educate the people to it, but not nearly so long as it would to induce the people of this county to revert to the old practice of hog scalding."

EXPLODING FIRE EXTINGUISHER.

Extinguishing a fire as soon as it starts by means of a globe which the heat causes to fall and explode is a new process made possible by a Chicagoan's invention. The heat fuses a metal plug which works the automatic release causing the ball to drop. The explosive extinguishing agent is contained in a globe which is suspended near the place where a fire is liable to start. As soon as the globe falls to the floor, a sliding hammer in the interior explodes the sphere and scatters the fire-quenching powder broadcast, at the same time making noise enough to alarm any one within the building. This extinguisher can be suspended at any point, without connection with any other apparatus, working independently in accomplishing its purpose, while at the same time it can be thrown by the hand should the fire be discovered before it drops of its own accord.

"STAR" FOOT AND POWER LATHES



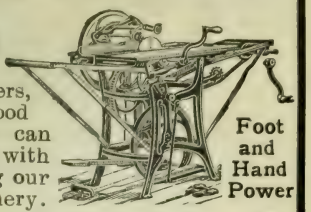
Are used extensively by repair shops, tool-makers, gun-smiths, experimental and model makers, etc.

Built for durable and fine accurate service, containing throughout the highest type of modern construction. 9 to 14 inch Swing.

SEND FOR CATALOG "B."

Wood Working Machinery

COMPLETE OUTFITS



Foot and Hand Power

Carpenters, builders, cabinet-makers, wood workers and others can successfully compete with large shops by using our labor-saving machinery.

SEND FOR CATALOG "A."

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N.Y., U.S.A. Adv. No. 44.

JAHN AND OLLIER ENGRAVING CO.

DESIGNERS, ILLUSTRATORS, HALF-TONE, ZINC, WOOD ENGRAVERS, AND ELECTROTYPERS.

We Make a Specialt of Fine Mechanical Engraving

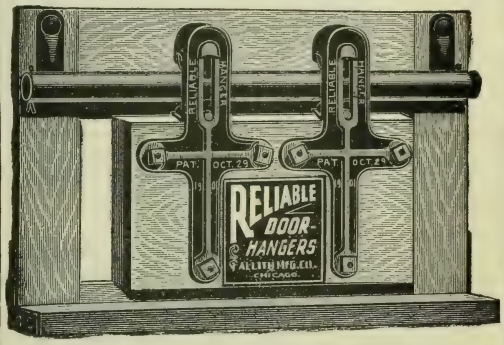
Call us up or Write for Estimates or Samples

264-266-268-270 FIFTH AVE.

CHICAGO

Telephones: HARRISON 4800, AUTOMATIC 7210

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks

Ours Will Not Bind

Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.

120 South Green Street, Chicago

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.

MOTORS

$5.00 Buys a
COMPLETE PRACTICAL BATTERY MOTOR—Not a Toy

WALSH'S SONS & CO.
250 Washington St. - Newark, N. J.

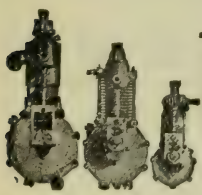
COPPER
LIGHTNING RODS

WEATHER VANES
TOWER ORNAMENTS
CHURCH CROSSES,
COPPER FINIALS, etc.

80 page Illustrated Catalogue mailed free
T. W. JONES, Mfr., 18 Fletcher St., N. Y. Est. 1862

SUPPLIES
DIRT CHEAP
Write for Catalogue and Green Discount
THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago

When You Want Special Jobs Done in Sheet Metal
get in touch with us. We make
Steel Tanks, Conveyor Troughs, Hoppers, Trucks, Chutes
In fact, anything of Sheet Steel, Galvanized Iron, Tin or Copper, accurately and promptly at reasonable prices
LYON METALLIC MANUFACTURING CO.
18-20 South Ann St., Chicago.



1 3-4 H. P. Bike Motor $7.50
Castings with Drawings 1904 Model
Now is the time to make that motocyc'e and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready.
Send for circular to
EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

SPROCKETS
and EQUALIZING GEAR
IN STOCK OR TO ORDER.
We can save you money. No order too small or too large. CATALOG FREE.
CULLMAN WHEEL CO., 521-525 Larrabee St., Chicago

Every Bicycle a Motor Cycle

by using one of our ATTACHABLE MOTOR outfits. Thoroughly practical. Can be applied to any wheel. On the market four years. Also Motors and Castings for Bicycle, Automobile, Marine or Stationary.
LOWEST PRICES. 2-cent stamp gets our catalogue.
STEFFEY MFG. CO., Brown & Pennock Sts., Philad'a, Pa.

KEEP ON KEEPIN' ON.

If the day looks kinder gloomy
An' your chances kinder slim,
If the situation's puzzlin'
An' the prospects awful grim,
An' perplexities keep pressin'
Till all hope is nearly gone,
Jus' bristle up and grit your teeth,
An' keep on keepin' on.

Fumin' never wins a fight,
An' frettin' never pays;
There ain't no good in broodin' in
These pessimistic ways;
Smile jus' kinder cheerfully
When hope is nearly gone,
An' bristle up and grit your teeth,
An' keep on keepin' on.

There ain't no use in growlin'
An' grumblin' all the time,
When music's ringin' everywhere,
An everything's a rhyme;
Jus' keep on smilin' cheerfully,
If hope is nearly gone,
An' bristle up and grit your teeth,
An' keep on keepin' on.
—New Orleans Times-Democrat.

This is going the rounds of Wall street. A broker from the financial vortex sought admission at the pearly gates. "Who are you?" said St. Peter. "I am a Wall street broker." "What have you done that entitles you to admission?" "Well, I saw a decrepit woman in Broadway the other day and gave her two cents." "Gabriel, is that on the records?" "Yes, St. Peter, it's marked to his credit." "What else have you done?" "Well, I crossed the Brooklyn bridge the other night and met a newsboy half frozen to death and gave him one cent." "Gabriel, is that on the records?" "Yes, St. Peter." "What else have you done?" "Well, I can't recollect anything else just now." "Gabriel, what do you think we ought to do with this fellow?" "Oh, give him back his three cents and tell him to go to hell."

AMERICA'S GREATEST MECHANICAL MONTHLY.

The New York American says: "Popular Mechanics is perhaps the most progressive and interesting monthly publication of mechanical and inventive progress in America."

DEVICE FOR SOLVING HARD PROBLEMS.

Would you like to add 1-128 to 37-64 and then subtract 5-16 without ever touching a pencil? Would you like to do so as quickly as you have read these words, and know the result will be absolutely correct, that it is simply impossible to make a mistake? Such a device has been perfected, and is called a Fractometer; it will prove a special boon to draftsmen, mechanics, engineers and all who use fractions. The thousands of combinations in fractions up to 128ths can all be instantly worked by a simple turn of the disc, and so easy to understand that a ten-year-old boy can solve the most difficult additions and substractions that any professor in mathematics may impose.

MAGAZINE FOR PATTERNMAKERS.

The Patternmaker is the appropriate name of a new magazine for that craft, and the first number is both handsome and interesting. It is published by the Iron and Steel Press Co., Cleveland, which also issues the Foundry.

GOOD INVESTMENTS

I have recently been selling the stock of two oil companies—**The People's Union Oil Company and the Illinois-Colorado Oil, Gas and Coal Company**—which have been placed on a dividend-paying basis and in less time than it takes the averrge man to think the situation over. : : : : : : : : : :

DON'T

invest your money with the long-winded, slow-poke promoter. Life is too short for that. What one wants in making investments are dividends.

IF YOU WANT A GOOD INVESTMENT LET ME HEAR FROM YOU

WILKIE P. GARRISON

A1103 Unity Bldg. **CHICAGO, ILLINOIS**

The mechanical principles that have been proven best in all typewriters find concrete expression in the Standard

CHICAGO TYPEWRITER

$35.00

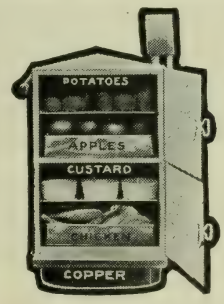
This almost human piece of mechanism exceeds the capacity of the most skilled fingers

CHICAGO WRITING MACHINE CO.

76 WENDELL STREET, - CHICAGO

DON'T STAND OVER A HOT STOVE

Make Summer Cooking a Pleasure by Using



O-HI-O Steam Cooker

WITH TWO DOORS

PRICES, $2.50 TO $9.50

ADVANTAGES

1. Cooks entire meal over one burner, any style stove.
2. **Saves 50 pr cent in fuel.**
3. Food CANNOT be burned.
4. Food always steaming hot.
5. Food not spoiled by waiting meal.
6. **Saves 50 per ct. in food**
7. Meats always tender. No evaporation. **Saves 25 per cent. in meat bills.**
8. Steam cooked food always easily digested. Cures dyspepsia.
9. **Saves 50 per cent in doctor's bills.**
10. Cooker once filled will cook entire meal from soup to dessert without further attention. Can't overcook.
11. **Saves 50 per cent in labor.**
12. **Takes the place of a cook or makes a good cook out of a poor one. No mistakes.**

FINE EOR SUMMER COTTAGES

GRAND FOR CANNING FRUIT

Handsomely Illustrated Catalog Free

WE WANT GOOD AGENTS and will guarantee them $30 to $40 per week and expenses. Write now and start in business for yourself before your territory is given to another.

THE OHIO COOKER COMPANY

759 Jeff Avenue, Toledo, O.

MODELS & GEARS
CATALOGUES FREE
UNION MODEL WORKS
193 CLARK CHICAGO.

F. D. CROFOOT N. NIELSON
BLUE PRINTING BY ELECTRIC LIGHT
BLUE PRINTERS BLUE PRINTING, BLACK PRINTING, BLUE LINE & COLOR PRINTING
WRITE FOR PRICES.
CROFOOT, NEILSEN & CO.
167-169 E. Washington St. - - CHICAGO

MODELS
CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES
ESTABLISHED 1867

MODELS AND SUPPLIES
WE MAKE
Working Models of Your Invention
After drawing or description, and charge moderate and fixed price for them. Experience, skill and modern equipped shop enables us to satisfy and assist you.
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Ave., Chicago

DIES, TOOLS, MODELS AND SPECIAL MACHINERY
Metal Specialties and Stampings Manufactured
HOEFT & MOORE, Chicago, U. S. A.
OFFICE: 85-87 Fifth Ave. WORKS: Indiana and Franklin Sts.

FOOT and POWER
AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::
SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

SPECIAL MANUFACTURING
Special MACHINERY-MODELS-EXPERIMENTAL WORK. DIES and STAMPING. Prompt. "Write for our booklet." The GLOBE MACH. & STAMPING CO.
970 Hamilton Street . . . Cleveland, Ohio

A TELEPHONE TRAGEDY.

The man stood at the telephone
And howled to raise the dead;
The Fire Fiend even shuddered at
The awful things he said.

He jabbed the trumpet in his ear
And with a gasping groan
He shrieked a prayer for mercy through
The soulless telephone.

"Give me the fire department—quick!"
He cried, "Oh haste, I pray!"
Eftsoon came back a languid voice:
"What number did you say?"

The man he danced a frenzied jig
And shouted it once more;
Around he heard with sore affright
The conflagration roar.

"Hey, Central!" shrieked he then at last,
"My whiskers are on fire!
Get busy, ere my dwelling place
Become my funeral pyre!"

All agonized he waited on,
To swoon with sorrow when
The yawning spirit voice came back
"Line's busy; call again."

* * * *

They found his charred remains beneath
The blackened brick and stone;
And still into his ear was jammed
The party telephone.

—Sunset Magazine.

POWDER USED AFTER FIFTY YEARS.

W. A. Clark, of Potsdam, N. Y., writes: "I have in my possession some powder that was bought about 50 years ago by my uncle and grandfather. They owned two rifles and did a lot of shooting. They stored their powder in a large stone heap on my father's farm. Uncle took to fever and died; grandfather never shot much and died not long afterward; my father was no gunner, so the powder, or a portion of it, was left unmolested. About 15 years ago I went and dug it up. There was a large flat stone over the box and about two dozen quarter-pound cans—round cans, I think—with an Indian's picture on each one. They were badly rusted. I picked the rusty cans from around the caked powder, broke it up and sifted out the dust, leaving the powder looking quite natural but for some red grains that showed the rust. I saved four pounds. I never tried it until last fall when I loaded a number of shells with it and some powder bought recently. The old powder shot fully as strong as the new.

HINTS TO INVENTORS.

The French government has offered three prizes for the best "reckoner" to be used in measuring alcohol on its production. The first prize is of 5,000 francs ($965); the second 3,000 francs ($579), and the third 2,000 francs ($386). The contest is open to all inventors in America. Competitors must give notice before Dec. 1, 1904. The internal revenue tax levied upon alcohol in France is calculated upon the volume of pure alcohol contained in a liquid at a temperature of 15 degrees. It is therefore desired to get a "reckoner" or "compteur," as the French call it, that will determine with certainty this degree as the liquid comes from the distilling apparatus.

10,000 GALLONS

Drake's Palmetto Wine

GIVEN AWAY FREE

A Complete Cure. Radical Remedy. Peerless Preventive.

Cures all diseases of the *Stomach, Bowels, Kidneys, Liver.* Cures *Rheumatism, Catarrh, Neuralgia.*

How do we know it is a *certain cure?* We know it because most distinguished *medical* men say so; because former *sufferers* say so; because *all who have tried it* say so.

A pure, delightful, wholesome *remedy.* A remedy not for a day nor a year. It affords a *permanent cure.* And the trouble *never recurs.*

And it is *an unfailing cure.* Thousands of thousands tell of its success. No one hints of a failure.

This is distinctively *the age of medicine.* This Wine is our contribution, and represents a *lifetime of study.* If most malignant diseases are curable, we believe that the above must be. The result shows that we were right.

"A bottle free!" you say. "How can you afford it? One bottle may cure me."

So it may, and so it will, unless your case is chronic. But, if you will not need to *buy* from us, your friends will, and we shall not make these gifts forever.

If your case is chronic the use of the first bottle will convince you that chronic ailments must yield to this remedy. It cures the diseases named, at *any and every stage.*

It is a natural remedy and so simple that others may soon learn its nature. They are making strenuous efforts to learn it and perhaps will. Meanwhile let us enjoy the triumph that they themselves have awarded to us.

Edw. C. Ryan, Laurel Spring, N. J.: "I believe you have the best remedy on earth."

Fred Hoole, Hillsboro, Ill.: "I think Drake's Palmetto Wine is the best thing to cure *Constipation* I have ever found."

Mrs. Myra Monte, Geneva, Wis.: "It is the very best medicine for *stomach* trouble."

Mrs. E. M. Marston, Lakewood, N. J.: "It acts on the liver the best any medicine I ever took."

Emma Ransdell, Turner Station, Ky.: "The only medicine that has ever helped my *kidney* trouble."

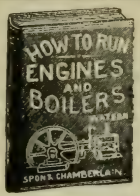
Fayette Smith, Wisconsin Vets. Home: "Surpasses anything. My *rheumatism* is fast abating."

We have such letters by the thousands. We have no record of a single failure. Are we over-confident when we say that Drake's Palmetto Wine Compound *will effect a cure in every case?*

For sale at your druggist's, or get directly from us. Retail price, 75 cents a bottle.

Send for a Free Bottle at Once. Do it Now.

DRAKE FORMULA COMPANY 910 Drake Building, Chicago, Ill.



7,000 COPIES SOLD

THE BEST BOOK to HELP YOU MAKE **MORE WAGES**

Written in plain language and fully illustrated.

Spon & Chamberlain Dept. P.M. Liberty Bldg., New York **FREE for $1.00**

CEMENT BOOKS

DO YOUR OWN CEMENT WORK

Full information in the following books:

"How to Use Portland Cement" - - - - - - Price $ .50
"Portland Cement Sidewalk Constructions" - - - " .50
"Architects' and Engineers' Hand Book of Reinforced Concrete Constructions" - - - - - - - " 2.00

Delivered free on receipt of price. Address

Cement & Engineering News, 164 La Salle St., Chicago, Ill.

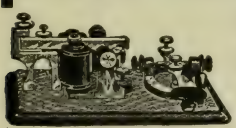
FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly..

$2.00 a Year

WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.

LEARN TELEGRAPHY AT HOME

No Fees to Pay. Learner's Set and Instruction Book $1.75



Salaries $60 to $150 a month. Any boy or girl can learn. Two instruments like cut, 50 ft. wire, 2 dry cells, $4.25. Best Dry Batteries 30c each.

ELECTRIC NOVELTY CO.
16 E. Market St., Indianapolis

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

SEND FOR

Popular Mechanics PREMIUM LIST

JUST OUT

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

Please mention Popular Mechanics when writing advertisers.

I WANTER GO.

Somehow about 'most every spring
I git a restless fidgeting,
A hankering to go
Away somewhere
An' I don't care,
Jest so
It's go.

I half b'lieve there's Injun nature
In every kind of mortal creature,
Which, when the sap do flow,
Will hustle men
Somehow agen,
Yer know,
To go.

For when the pussy-willows fly
Their yaller banners, somehow I
Jest but one thing can know—
It's really spring;
The proper thing
I know
Is "go."

The bluebird sez, "It's time ter move;
Jest 'cross the hill is waitin' love."
'Tis silly-like, I know,
But then, behind
We're sure to find
It slow
An' go!

A RABBIT CANNERY.

A rabbit cannery is the very latest American enterprise. Rabbits are the most prolific of all meat producing animals, and the cost of the "live stock" will be comparatively insignificant. E. S. Sylvester, of Echo Mountain, Oregon, is to be at the head of this new industry. He expects to can rabbits by the thousands, and from their meat he will produce "chicken" tamales, all kinds of canned chicken products, "lobster" salad, and many kinds of famous "French" soups. The rabbit meat has been found to make the finest kind of tamales, and the products are being shipped by the wholesale to New Mexico and California.

A new device to prevent the escape of insane patients consists of a simple electric contrivance placed under the rug by the bedside. As soon as any one steps on the rug an electric current is closed and a bell rings wherever desired.

Popular Mechanics

Vol. 6. No. 6. CHICAGO, JUNE, 1904. 10 Cents a copy. $1.00 a year.

Is the Day of the Armored Battleship Ending?

The Evolution of the Fighting Vessel Shows That All Great Conflicts Have Produced Radical Changes in Style of Construction

The Old and the New

Has the great modern steel armored battleship become a thing of uselessness? Is this Goliath of the main helpless in combat with the little torpedo craft, which, David-like, can hurl the missiles that wreak destruction on its giant adversary? Has the United States made a bad investment in spending $150,000,000 on battleships?

Often in the past it has been that a new type of fighting machine has completely revolutionized warfare. A newly invented death-dealing device has frequently decided the fate of war. An inventor many times has conquered armies where forces of men and ships have failed. So it has been since the beginning of wars that the side which could devise the most effective weapons of destruction has won the greatest victories, for it is war's mission to destroy. The evolution of the ironclad battleship is one demonstration of this truth. The evolution of fire arms tells the same story. First one means of combat and then another has passed into oblivion, from the times of the sling shot, the cross-bow and the javelin on land, each giving way to more formidable weapons, until now we have the mauser rifle and the gatling gun. On the sea, the galley, the sailing vessel and the wooden battleship have each in turn given way to stronger, more destructive craft, until now we have the great steel armored vessels. And in the Japanese-Russian war these great steel armored vessels have been blown to atoms by the little torpedoes and submarine mines. Hence the question has arisen, is an era of new marine fighting methods upon us? Is the heavy steel armored vessel longer useful?

Senator Hale of the United States in a

Proof of Necessity for Ironclads; Wooden Ships "Agamemnon" and "Sans-pareil," under Shell-Fire of the Sebastopol Forts, 1854

recent congressional session contended that the battleship is at the mercy of the torpedo and is a valueless, dangerous investment. So effective was his contention, that the United States government has probably decided to devote more of its means and energies to the building of first-class cruisers and torpedo boats instead of battleships. The naval appropriation bill, over which the argument arose, gives the President and Secretary of the Navy discretion to defer the construction of the battleship authorized by it. It is contended that the modern war vessel with its steel armament and great guns is so heavy that with slight injury it turns turtle and sinks as did the "Petropavlovsk" and the "Victoria."

H. M. S. "Achilles," the First British Warship with Complete Armor Belt

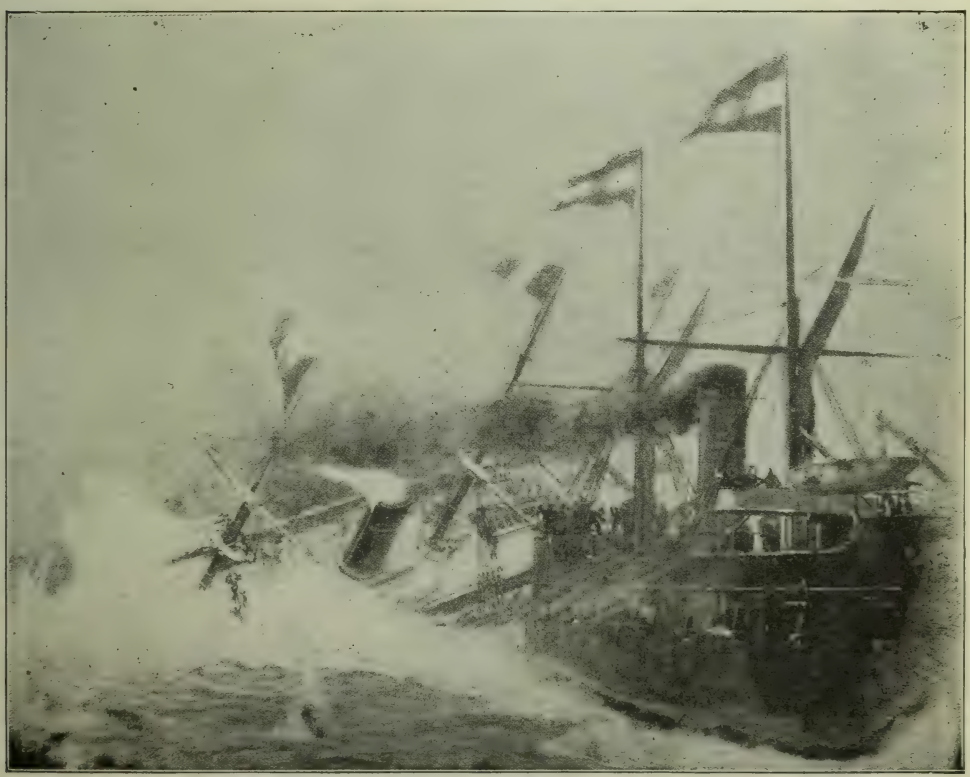
A recently printed comment on marine warfare states: "The remarkable success of the Japanese at Port Arthur—the crippling of the 'Retvizan' and the 'Czarevitch' with torpedoes, and the sinking of the 'Petropavlovsk' and the disabling of the 'Pobieda' by contact mines—has filled many with sudden contempt for battleships. They say that a revolution has been worked in naval warfare and that the fighting nations of the earth will be obliged to discard the vulnerable engines of war, into which they have put so much money, and build more torpedo boats, especially submarine ones, and torpedo boat destroyers."

Every great war brings forth radical changes in fighting machines that affect the whole world; makes many time-honored

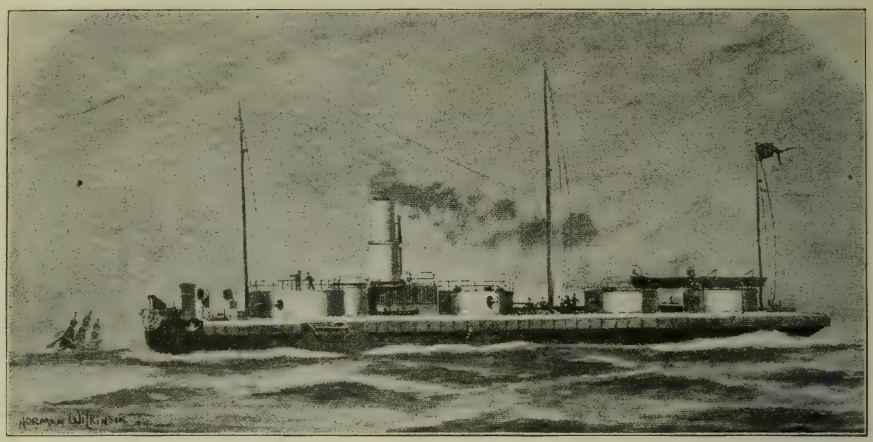
devices useless and ushers into general usage new and more formidable contrivances. As the Civil War in the United States brought forth the submarine mine and the torpedo, so it introduced the armored ship in battle and the turret vessel, both of which revolutionized the navies of the world and are responsible for our present types of fighting vessels.

Shells were used for the first time by ships against ships on Nov. 30, 1853, when the Russians attacked and destroyed a squadron of Turkish frigates at Sinope on the north coast of Asia Minor. The Russian guns were provided with shells and the result of their fire was disastrous to the Turkish squadron. Every one of the Turkish ships, except a small steamer which escaped, was in flames in a few minutes, and burned. English vessels suffered severely from shell-fire at the bombardment of Sebastopol on October 17 of the following year. This great siege marked a new era in the building and equipment of war vessels, which hitherto had been practically the same for two centuries. It became evident that unless some means of protection could

First Use of Ironclads; the French Floating Batteries Bombarding Kinburn with Impunity, October 17, 1855



In the Days of the Ram--The Austrian Flagship "Ferdinand Max," Ramming and Sinking the Italian Armored Frigate "Re D'Italia" at the Battle of Lissa, July 20, 1866



First Turret-Ship: The "Royal Sovereign," as Remodeled in Consequence of the "Monitor"-"Merrimac" Duel, 1862

be devised, ships could no longer hope to attack shore batteries provided with shell guns, with any chance of success.

During 1855 a certain number of what were called floating batteries were built in France and England. They carried a heavy armament—sixteen 68-pounders—and they were protected by four inches of iron on 20 inches of wood, with a bullet-proof iron shelter for the helmsman, from which has sprung the modern conning tower. Three of these French floating batteries aided the English in the attack on Kinburn, Oct. 17, 1855. Anchored some 800 yards from the main fort, their heavy guns poured a crushing fire upon the Russian works, while the shot and shell from the Russians produced absolutely no effect upon them. "Everything may be expected from these formidable engines of war," wrote Vice-Admiral Bruat, the French commander-in-chief, in his report to the emperor.

First Sea-Going Ironclad: French Vessel, "Gloire," Launched 1860

After that the French built the "Gloire," the first sea-going ironclad, and the "Black Prince," and others followed in close succession, but it remained for the United States later to demonstrate the formidability of the ironclad in actual battle. The armor of all these European vessels was much the same and consisted of a 6-inch belt at the waterline tapering to four inches on other parts of the hull. The principal armament was still carried on the main deck as in the old wooden frigates. One important change was to be noted, however. The old smooth-bore gun had given way to the rifled, and the weight and size of the new guns had already materially increased. Instead of the 68-pounder the ships were armed with a 7-inch 6½-ton gun, which threw a projectile of 115 pounds.

How formidable a weapon the ram may be in warfare is shown by the sinking of the Italian armored frigate "Re d'Italia," at the Battle of Lissa, July 20, 1866, by the Austrian flagship, the "Ferdinand Max;" the sinking of the "Vanguard" by the "Iron Duke" in the Irish channel, Sept. 1, 1875, and the "Victoria" by the "Camperdown" in 1893, which latter ship sunk within 10 minutes after having been struck.

The introduction of rifled guns marked a turning point in the history of the navy and was distinctly due to the introduction of armor, as it soon became evident that the heaviest spherical projectile from a smooth-bore gun was quite inadequate to pierce the newly adopted armor-plates. Experiments soon

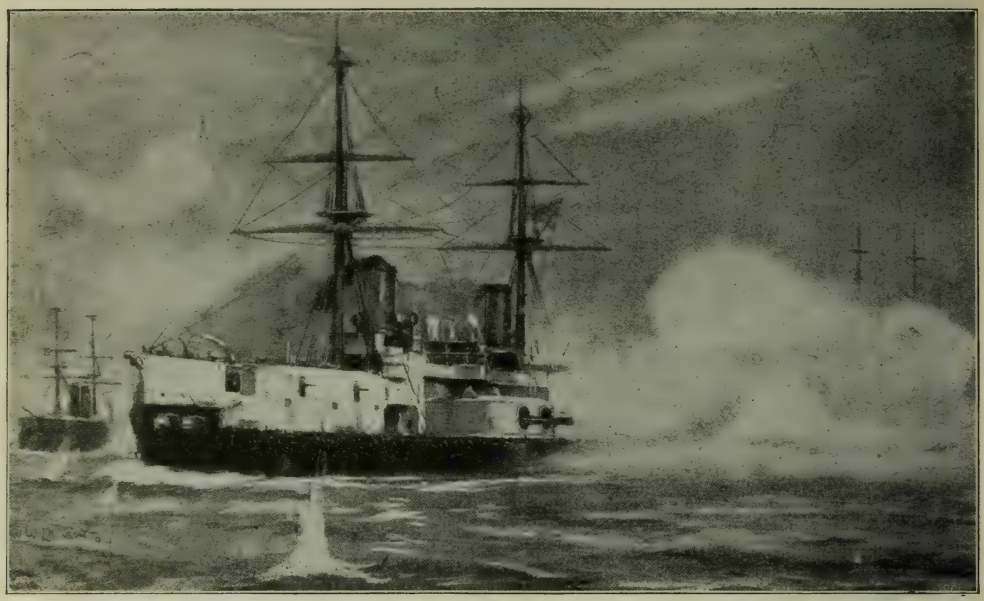
Battle of the "Merrimac" and the "Monitor," March 9, 1862

showed that only to projectiles of an elongated form, combining as much weight as possible with small diameter, could the velocity and penetrating force be given which would cope successfully with the new defensive powers afforded to ships by armor-plating. Elongated projectiles, however, have a tendency to turn end over end, as the pressure of the air acts unequally upon them when they have left the bore of the gun; and to counteract this tendency and to keep the projectile point foremost, it was necessary to make it spin or rotate about its longer axis, and this could only be done by means of rifling. Rifled guns thus became a necessity and with their definite adoption in 1864 began the great contest between guns and armor, which has lasted ever since and which is now being carried on with as much energy as ever.

The London Illustrated News says: "The Civil War in the United States broke out in 1860 and on March 9, 1862, there was fought in Hampton Roads the first naval action between armored ships, the result of which was destined ere long to revolutionize the whole system of battleship construction."

When Norfolk, with its dockyard, was evacuated by the federal troops, the "Merrimac," a large 60-gun frigate under repair, was set on fire to prevent her falling into the hands of the Confederates; she was only partly burnt, however, and the Confederates found her in all essential respects uninjured. Painfully conscious of their weakness at sea, the Confederate authorities determined to attempt the construction of an armored ship which would be able to cope successfully with the numerous wooden vessels of the Northern fleet. The Merrimac was cut down to the waterline and a rectangular casemate extending from two feet below the waterline to seven feet above was then built over her, the sides of which were sloped at an angle of 35 degrees; they were made of 20 inches of pine, with an outer layer of four inches of oak, on which were secured two layers of armor-plating, manufactured from railway rails. She carried 10 guns, including a 100-pounder Armstrong

Last Broadside Battleship, H. M. S. "Alexandra," Launched 1875



The First "Citadel" Ship and the Last to Carry Muzzle-Loading Rifled Guns and Iron Armor: H. M. S. "Inflexible," at Bombardment of Alexandria

gun mounted at each end of the casemate. The "Merrimac" was spreading desolation in her path when her career was finally and abruptly checked by an antagonist, which though much smaller, proved more than a match for her. This antagonist was the celebrated "Monitor," built and designed by Captain Ericsson. She was 210 feet long and was only two feet out of the water; her deck and her low sides were plated, and she carried two 150-pound Dahlgren guns in a single turret amidships, which was worked by steam and protected by eight 1-inch iron plates screwed together, while besides the turret nothing showed on deck except her funnel and armored pilot-house. She thus offered nothing as a target except her turret which proved impenetrable to the "Merrimac's" guns, while the heavier ones she herself carried inflicted considerable damage to her opponent's casemate, so that the "Merrimac" was eventually forced to withdraw. It was, to a certain extent, a draw battle; but indecisive as it was, it really settled the question of "broadside" versus "turret" in favor of the latter.

The "King Edward VII," the greatest war vessel ever built, is a descendent of the little "Monitor." The London News further says:

"The step between the 'King Edward VII' of today and the insignificant-looking little 'Monitor' of 1862 is a very long one, and the connection between the two ships may not, at first sight, be apparent; but the barbettes on the center line of the modern battleship, in which her heavy guns are mounted, are simply a development of the turret principle, the value of which was so fully proved in Ericsson's experimental vessel on the calm March morning in 1862.

"Great was the excitement caused, especially in England, when the news of the action arrived and a demand immediately arose for conversion of our fleet into turret ships."

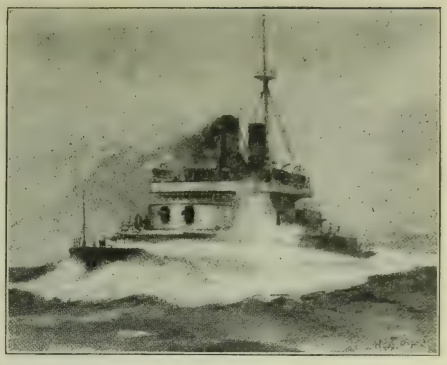
In England and everywhere the rebuilding of battleships was made necessary. The "Royal Sovereign" of the British navy was cut down, armor-plated and fitted with four turrets, each carrying four 9-ton guns. The weight was too heavy for the hull and she was not a decided success. She was followed by small double-turreted vessels, built for the English coast defense and in 1870 the two large sea-going turret ships "Monarch" and "Captain" were completed in England. Similar vessels were constructed by all leading navies of the world.

The "Devastation," "Thunderer" and "Dreadnaught," built by England in 1872, were the first ships to be provided with the "military mast," fitted with a fighting top in which are carried small quick-firing guns;

they had two sets of engines driving twin screws, a system which was rapidly superseding the single screw in warships, owing to the extreme handiness in maneuvering. The "Devastation" carried two 25-ton guns in each of her turrets; she was of 9,330 tons displacement and at that time was the most powerful warship afloat. Another improvement which had now become general was the introduction of the double bottom and the division of the ship into a number of watertight compartments, which all tended vastly to increase her power of remaining afloat in case of serious injury. Six years before the completion of the "Devastation" the British flagship in the Mediterranean was a wooden three-decker and thirteen years before, there was no sea-going armored ship afloat. Therefore the change that transpired in this period, brought about by the battle of the "Merrimac" and the "Monitor," is the most wonderful and startling in naval history.

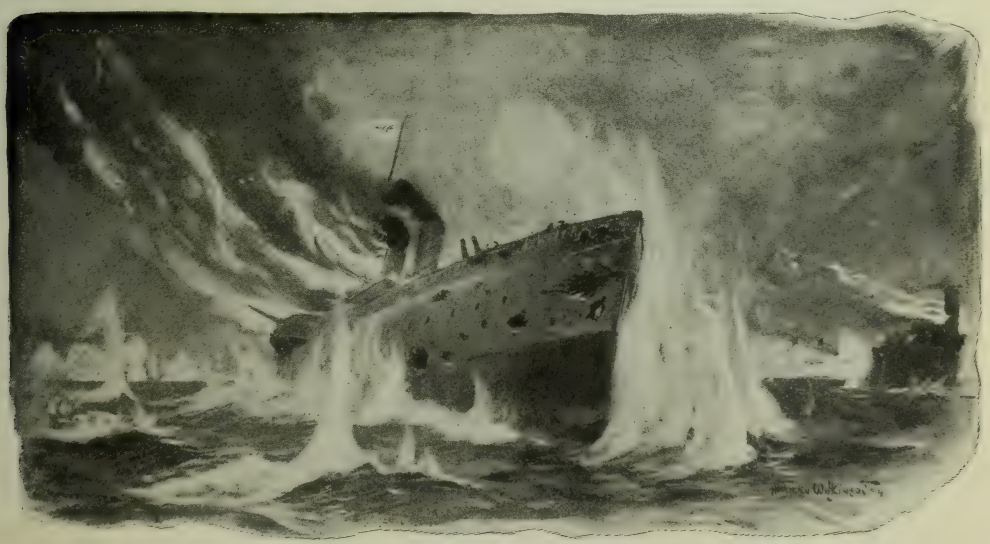
In 1875 England and most other nations had entirely abandoned the construction of broadside battleships. In 1881 the "Inflexible" the first of what is known as the citadel type of ship, was built in England. This was also the last ship of the naval powers to carry muzzle-loading rifled guns and to be protected with iron armor.

France, Russia and Germany followed each other in close succession in the adoption of breech-loading ordnance in the latter part of the seventies. England and the United



A Notable Departure in Turret-Ship Construction; H. M. S. "Devastation" Armed with Four 25-Ton Guns, Two in Each Turret, Launched 1872

States were tardy in this improvement. In 1882 builders of warships began the mounting of heavy guns in barbettes instead of turrets, and the construction of a broadside battery for 6-inch quick-firing guns between the barbettes. This supplementing of the heavy guns of ships by a secondary battery of lighter guns had been rendered necessary by the advent of the torpedo boat and to the necessity of meeting the attacks of these formidable little vessels we are indebted for the rapid development of the quick-firing system, which has been one of the marked features in the improvement of ordnance in the last few years. The



Battle of Yalu River, 1894.--The First Real Test of Modern Ironclads in Action

Model of Most Modern Type of Battleship: H. M. S. "Royal Sovereign"

barbette has since been definitely adopted in place of the turret. When the guns were mounted in turrets, the turrets revolved, carrying the guns with them. Where the guns are mounted in barbettes, the guns are on turntables which revolve with them inside the barbette, which is itself a fixed heavily armored redoubt, the guns firing over the top. The great advantage of the barbette system is that the guns are carried much higher out of the water. In the earlier ships the guns were exposed and were thus liable to injury from the enemy's fire. This defect has been remedied by protecting the guns with heavy steel hoods, which revolve with them.

The "Royal Sovereign" class of battleships, built in Great Britain through the passing of the Naval Defense act in 1889, formed a model after which vessels of most every country have since been built. These craft have a displacement of 14,150 tons. They are 380 feet long, with a beam of 75 feet and carry four 67-ton guns in barbettes. Protection is afforded by an 18-inch waterline belt running for two-thirds the length of the whole ship, terminated at each end by 16-inch armor transverse bulkheads. At each end of this are the armored citadels for the barbettes, protected by 17-inch compound armor, the barbettes themselves being similarly protected, while armored ammunition tubes are carried down from the turntables to the top of the armored deck. This arrangement precludes the possibility of the bursting of shells under the floors of the barbettes, upon which the revolving gun platforms are carried. Between the barbettes the side is protected to the height of the main deck by 5-inch steel armor. Further protection is afforded by a 3-inch armored deck resting on top of the belt.

In 1893 new styles of battleships were built in America and England. They are simply an improvement on the "Royal Sovereign" type. In England they are known as the "Majestic" type and on them a uniform thickness of 9-inch armor of Harvey steel is substituted for the compound armor and thinner belt above the earlier ships, the whole depth of the armor in these ships being 16 feet, while the armored deck instead of being flat on top of the belt, curves downward on each side to the lower edge of the side armor, and as it is four inches thick, it adds enormously to the offensive resistance of the ship. In later built ships the disposition of the protective belt is practically the same, although in the armor which is now made of hard Krupp steel, it allows of a greater surface of the ship being protected. The armament, however, is the same—namely, four 12-inch guns, twelve 6-inch quick-firing guns, sixteen 12-pounder quick-firing guns, with some smaller ones, while they generally have four submerged tubes for discharging Whitehead torpedoes.

Even more powerful, but still heavier ships are now being built. The greatest are those of the "King Edward VII" type under construction in England. In them the displacement has been raised to 16,500 tons, while four 9.2-inch guns have been added to the heavy armament and are carried singly in small turrets, two on each side of the upper deck. It is reported that a still larger type of ship is to be built in England with a displacement of 18,000 tons. Should this be done the additional tonnage will probably be used to mount eight instead of four 9.2-inch guns, while the armor protection will be increased so as to cover nearly the whole hull.

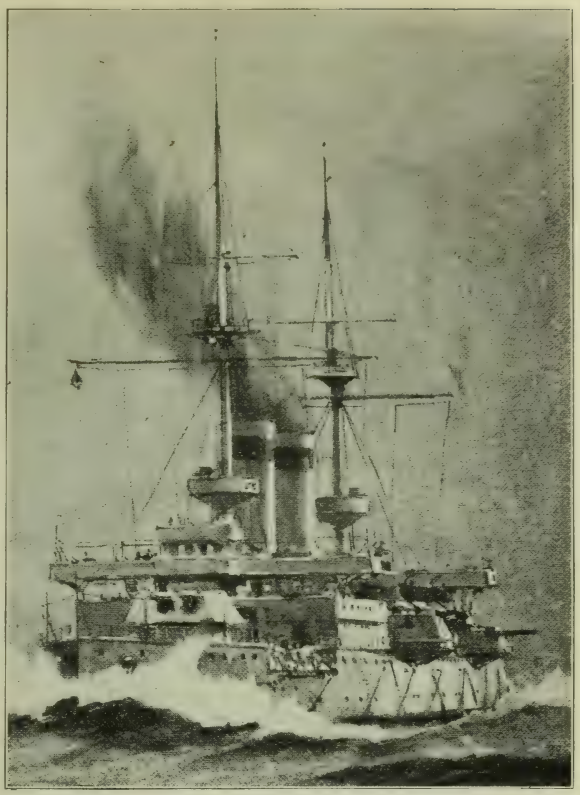
The "Petropavlovsk," Admiral Makaroff's flagship, which was destroyed at Port Arthur, April 13, was not as powerful as the late English and American built vessels, but she was one of the most formidable in the Russian fleet and a type of modern armored vessels. She was of 10,960 tons displacement and carried four 12-inch guns in her main battery. She was built in 1895.

With all her armament and powerful guns the "Petropavlovsk" was helpless against the mines or torpedoes by which she was destroyed. The cause of her destruction is not yet known. Some claim that it was by a Russian mine, some that it was by a mine planted by the Japanese, and some that the vessel was torpedoed by the Japanese. It will require a future investigation to accurately determine the cause. This much is known, however, that the "Petropavlovsk" was one of the Czar's greatest ships built at an enormous cost and that she was sunk almost instantly by some small machine of

comparatively insignificant cost. And the "Petropavlovsk" while affording the greatest loss that has yet been encountered by the Russians, is only one of the victims of the submarine explosives. Following are others similarly destroyed or damaged:

The "Czarevitch," battleship, torpedoed at Port Arthur, Feb. 8; the "Pallada," cruiser, torpedoed, Feb. 8; the "Askold," torpedoed, Feb. 8; the "Yenesei," transport, blown up by a mine near Port Arthur, Feb. 12, and 95 men perished; the "Boyarin," cruiser, blown up by a mine, Feb. 16, 195 men losing their lives; the "Steregoutchi," destroyer, sunk by torpedo, March 10, "Skori," blown up by mine.

With such a list of recent casualties, it is not to be wondered at that some people are beginning to wonder if the day of the great battleship is nearing an end; if the little submarine machine is not more destructive than the mightiest man of war a nation can build. Some have declared that the greater battleships only serve to give an enemy a chance to inflict greater loss. As nearly every other war has worked sweeping changes in the mechanism of fighting machines, it is not to be expected that the Japanese-Russian war will be an exception to the rule. Many naval experts claim that it has already taught the lesson that the future battleship must be a smaller, lighter craft, capable of great speed and with better equipment for avoiding the attacks of torpedoes. It would seem to us, however, that the great battleship still has its uses, and that no other fighting machine can take its place; but that a nation's navy should also be equipped with an ample number of cruisers, torpedo boats, torpedo boat destroyers, and swift moving vessels specially equipped for speedily laying and destroying mines. There is no doubt that naval battles of the future will be fought largely under water, but the great steel armored vessel will still be the main protection of the nation and the backbone of the navy.



Latest Design of English War Vessel--The "King Edward VII" to be the Greatest Battleship Ever Built

CARS SWITCHED BY GRAVITY.

In many of the large terminal and division yards in the United States, cars are now switched by gravity. In some cases a receiving yard is done away with entirely, the cars being run over a hump at the head of a yard and switched to the tracks on which they belong according to their destintions and the character of freight they carry. In this way hundreds of cars are handled expeditiously and systematically every day.

Perhaps one of the best arranged "hump" yards is the yard of the Pennsylvania line located at Altoona. Here the main westbound freight line divides into two tracks which pass over the scales and hump and 800 feet to the lead switch—from which point the cars are carried 2,000 feet. There are 15 classification tracks in all. At this yard 1,491 cars have been handled in 24 hours; one day 984 cars were handled in 12 hours. This hump has a grade of 4 per cent for 200 feet.

Send for Popular Mechanics premium list.

The Diver's Life is Full of Perils

Accident to William Hoar, However, the Worst in the History of the Business

By Capt. Andrews, New York's Veteran Diver

Men who make their living by toiling under water and breathing air pumped to them through a tube have met with many frightful experiences, but none with a more horrible fate than that which befell William Hoar at Boonton, N. J., a short time ago. Hopelessly pinned in the suction of a 4-foot outlet pipe, 65 feet under the surface of the new Boonton reservoir, Hoar's almost titanic strength gave way only after 22 hours of what must have been excruciating mental and physical agony. Hoar was known throughout his profession as an experienced diver and as a man of extraordinary endurance.

I have heard of a good many blood-curdling scares and fatal accidents and squeaks that would turn your hair gray, and I have had several narrow escapes myself, but poor Bill's scrape discounts them all.

One of the toughest accidents on record happened to a diver who met Hoar's fate about six years ago down in a 50-foot mill dam at Holyoke, Mass. The dam had sprung a leak near the bottom of the lake and a cataract of water as big round as a beer keg shot through the masonry and threatened every moment to enlarge the aperture and take the whole wall with it. The only hope to save the dam was to stop the leak by means of bags of Portland cement, and a diver was sent below to make a preliminary survey. He never so much as signaled. No sooner had he touched bottom than there came a quick vicious tug that almost hurled the tender into the water; then all was still save the air bubbles which rose to the surface, showing where the escape in the helmet was doing duty in releasing the used-up air pumped down through the hose to the man below. In vain the tender signaled, again and again inquiring whether all was well. There came no answering tug on the line, and when the combined strength of three men failed to budge the fellow underneath, another diver was sent to investigate. He found his mate doubled up, chin and knees together, hopelessly wedged six feet deep into the aperture. Not a sign of life was in the unfortunate man, nor was it possible to budge the body, which afterward was entombed by cementing up the hole.

Diver in Armor

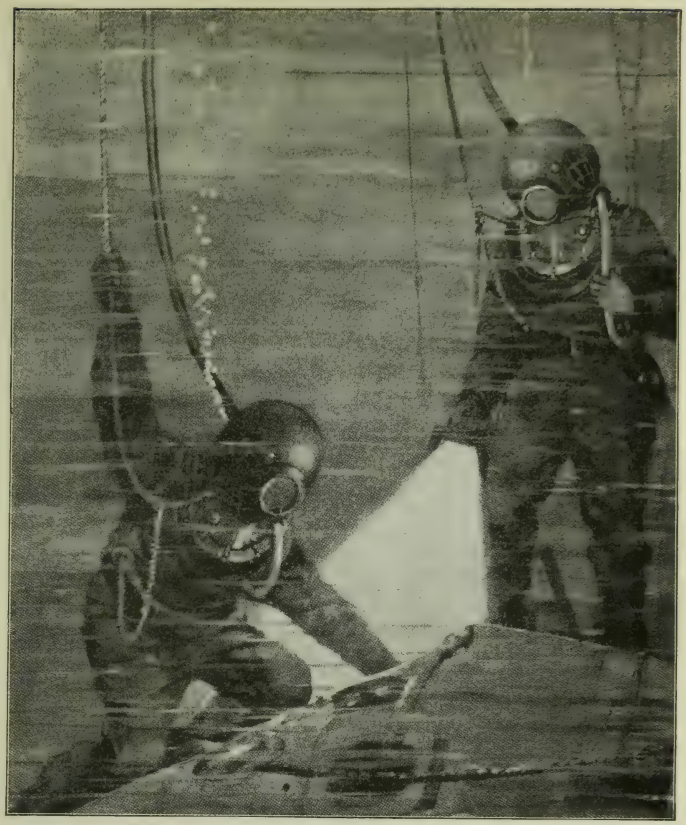
Here in New York harbor we have about as many narrow shaves as come to men in most parts of the country. A brig, the Chatfield Taylor, had "touched" one day on her way into port. According to the laws of the underwriters she had to be inspected before going back to sea. The vessel was anchored over in the mud flats off Communipaw, and I put off one of the coal docks, intending to walk out the hundred feet or so and examine her bottom. Everything seemed in perfect working order as I started. I could hear the regular, everlasting "click-click-click" of the triple-barrelled air pump and felt each gust of air as it came through the goose neck at the back of the helmet. Suddenly I started. The clicks had ceased abruptly. Something had gone wrong. For an instant I stood stock still scarcely able to believe my ears. I felt a thrill shoot through me from heels to hair. It was my first serious accident and in a moment I had lost my head and was all excitement. I forgot even to signal to be hoisted by the life line. I dared not stand up in the current, which would have swept me off my feet, and so I crawled back on hands and knees, following the line and the hose, all the time feeling the pressure of water increasing as the air escaped out of the helmet.

My hands and legs and trunk seemed to be grasped as if in a vice, and blood was being pressed to my head until my nose began to bleed and I grew giddy and weak under the strain of fear and scarcity of air. What might have happened is not hard to tell. But just as I was ready to give up, I felt a pull of the life line and then felt myself being dragged swiftly upward.

I was unconscious when pulled out and was bleeding at the mouth and nose and ears. My eyes had begun to start from their sockets. For a month I lay in a hospital, my face black with clots of blood

that had been driven up through the pores, and the whites of my eyes looking like burnt holes in a woolen blanket.

What had gone wrong? The hose I had used had been repaired and during the process some cement inside the tube had rolled itself into a ball along with dust and other foreign matter from the shops. When the air was started everything worked well, but after a time this ball was driven forward to the next coupling, where it lodged and stuffed the hose, cutting off all air. If the pumpers had not noticed that the air was forcing harder and harder and that the air gauge showed an excess of the required amount, I would not have been pulled out in time. As it was, for more than a year I could pinch my face, cheeks, chin or forehead and pull tiny bits of congested blood out of the skin.



Divers at Work Trying to Release William Hoar at Boonton, N. J.

A brave fight for life was put up by a poor fellow while working for the Baxter Wrecking Company on a three-master, sunk off West 38th street, New York. In some way Woods' hose and life line became entangled so that he could not signal. It was found afterward that both strands were wound about the fluke and anchor. What happens to so many divers when in serious trouble, happened to Woods. He lost his head. Had he remained perfectly still, the chances are that repeatedly unanswered signals from above would have brought help, and he might have been freed of his predicament. But in his fright he tried to cut himself free, to sever the life-line in the hope of being able to untangle the hose. Not succeeding, he did the most foolish thing he could do under the circumstances —he drew a jack knife out of his overalls and began to slash at his hose.

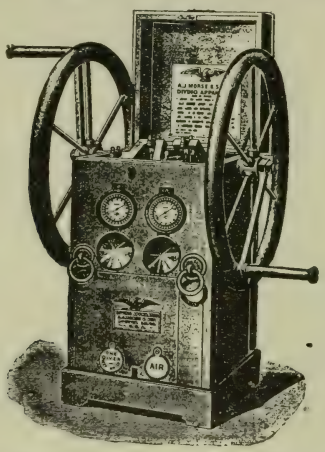
On shore, or in daylight, he would have had little trouble cutting through the rubber in three or four successive slashes, but down in the darkness of the river bottom he could not keep his blade in the same place for two successive jabs, and he simply punctured that hose in a half dozen places, rendering it useless and cutting off his supply of air. Later he was brought up by his own brother, and his face and head were mutilated frightfully by the terrific pressure which had forced blood upward until his very eyes were driven out. Up in the Baxter Wrecking Company's offices they will show you that same piece of slashed hose to this day.

Probably Popular Mechanics' readers would like to know something about the equipment of a diver; the kind of clothes he wears and how he goes down into the water and remains there.

With the screwing on of his brass helmet a diver hands his life over to the keeping of his attendant and the men at the air pumps. Submarine diving is the hardest kind of work, requiring experience, skill, ingenuity and plenty of nerve. The occupation, however, is often exciting and commands good pay.

An outfit for diving in moderate depths includes the following articles: Air pump, $250; diving helmet, $100; two rubber dresses, $80; 150 feet air hose, $54; pair diving shoes with lead soles, $12; two pairs diving mittens, $10; two pairs diver's stockings, $2.50; pair sleeve expanders, $5; basket to pack helmet and suit in, $15, and numerous bolts, nuts, tools, etc., which bring the outfit up to $574. An outfit for very shallow work may be had for $375, while deep sea outfits cost $725, and up. This article will describe the dress and how a dive is made.

The diver, having taken off his own shoes, puts on a diver's flannel shirt, a pair of



Morse's Double-Action Air Pump, for Supplying Air to Divers

diver's drawers, carefully adjusted and drawn up outside the shirt, then his heavy stockings. If the water is cold he puts on two or even three suits of underclothes. If going into very deep water, cotton saturated with oil is put in the ears and a crinoline cap drawn down tightly over the ears. A pad is strapped on the shoulders to relieve the weight of the helmet and frame. He then gets into the diving dress, which in cold weather must first be warmed, drawing it well up to the waist; an assistant opens the cuffs with the sleeve expanders, the diver pushing his hands through. He then puts on his canvas overalls to protect the rubber suit.

The diver now sits down, the inner collar of the dress is drawn tightly and tied with spun yarn, and the breastplate carefully put on. This is in two parts, between which the neck of the rubber suit is tightly clamped. The shoes, weighing 10 to 20 pounds each, are now put on and strapped. If rubber mittens are to be used, they are next clamped to the cuff rings. He is now ready for the helmet, which is fastened with clamps or screwed on, according to the type of helmet. These helmets are made of tinned copper, with all mountings in finest gun metal, having three windows or lights of heavy plate glass, and are large enough to allow the diver to turn his head. In the Morse helmets, such as are furnished the navy, a safety valve prevents water coming into the helmet (and instantly drowning the diver) in case the air pipe is cut. An escape valve permits the air to flow out, thus maintaining pure air for the diver. A safety lock prevents the helmet becoming accidentally unscrewed.

The helmet is now adjusted in place, but the front plate is left off to admit air. The life line is next tied around the waist, brought up in front and secured with a bit of rope around the neck. The waist belt is buckled on with the knife on the left side, and the air hose screwed into the helmet. Two men are now ordered to "man the pumps." The diver steps on the ladder which extends a few feet down into the water and the weights are put over the shoulders.

The attendant now makes a most careful and final inspection, and if everything is right, gives the word "Pump," and screws on the front plate. Air now begins to discharge through the escape valve in the helmet. He then takes the life line in his hand and "pats" the top of the helmet with it, which is the order to the diver to descend. While the diver is below no laughing or talking is allowed, and the attendant must keep the life line in hand every instant. Some divers have a rope ladder reaching to the bottom, but experts prefer simply a rope heavily anchored as a guide down. After descending a few yards a halt is made to make sure everything is in proper working order. If he feels oppressed he must rise a yard or two, swallow his saliva several times and not go down until he feels comfortable. If oppression, headache, or singing in the ears continues he must return slowly to the surface. To dive to great depths, such as 120 or 150 feet, requires men of great practice and able to sustain the consequent pressure.

On arrival at the bottom he signals "All right," which is one pull on the life line. If he has to move away from the bottom of the ladder rope in thick water, he must carry a rope with him tied to the ladder rope to find his way back. If he loses his way, he must at once signal to be drawn

up. In traveling on the bottom he must return by the same path he went to avoid getting his air pipe and life line fouled around some obstacle. Where a diving telephone is used, orders are spoken after calling with a signal on the life line. One transmitter and receiver is fastened inside the helmet, and another set is beside the attendant. The telephone wires are inclosed in rubber and fastened to the life line. While the diver is down the attendant must frequently get an "all right" signal through the telephone or by the life line. If no answer is received the diver must be hauled up at once. In returning from great depths it is more important to rise slowly than in going down. The ascent from 120 feet should occupy five minutes in order to get accustomed to the great change in pressure from that depth to open air.

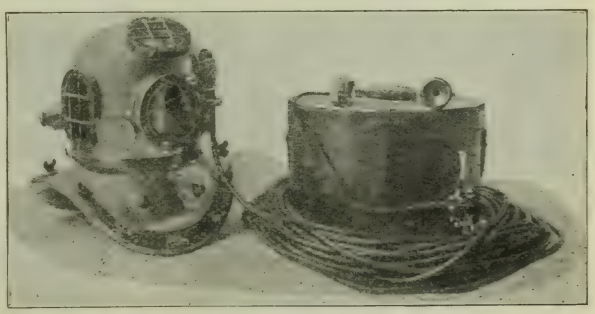
Two hundred and four feet beneath the water's surface is the greatest depth ever attained by a submarine diver. This was made possible by the latest improvements in armor, air supply, weights, life-lines, etc. In an effort of a diver to reach a wreck in 240 feet the diver experienced serious trouble at 130 feet and lost consciousness soon after passing the 200-foot depth.

These are some of the pressures per square inch at various depths: 20 ft., 8⅛ lbs.; 30 ft., 12¾ lbs.; 40 ft., 17¼ lbs.; 50 ft., 21¾ lbs.; 80 ft., 34¾ lbs; 100 ft., 43½ lbs.; 150 ft. (limit), 65¼ lbs.; 204 ft. (greatest depth any diver ever descended) 88½ lbs. For great depths the air pumps are driven by steam power instead of by hand. From the pressure indicated on the air pump gauge, one can easily calculate the depth at which the diver is working. The armor and weights will weigh 240 pounds.

The first time a man descends under water he is usually suffering from inherent nervousness, occasioned by the fact that he is engaged in an occupation hitherto unknown to him, consequently there is an increased pulse and peculiar gasping for breath; should these symptoms be marked it is not advisable, while in that condition to allow a man to descend. When the nervousness is overcome and the man calm, have him descend very slowly, swallowing his saliva and not demanding too much air, resting at times to recover his equilibrium; and if the pressure should cause too much pain in the head, gently ascend a few feet, and the descent can then be continued.

Divers Working on a Sunken Ship

The constitution of the diver will regulate the manner of his coming up. A man at all sanguineous should ascend slowly; the brain being suddenly relieved from the pressure causes a rush of blood to the head, and it may cause serious consequences. We would advise that a diver, a strong constitutioned man, should not ascend at a rate of over two feet every second. This course applies only to depths not exceeding 80 feet; greater depths require more care in ascending and more time in coming up, according to the increase in depth up to the limit of 150 feet. In ascending from very deep water, the diver having been in a condensed atmosphere, time should be given for the muscles and tissues of the body to be relieved of the pressure by very slowly ascending, or frequently stopping for a time at certain stages, to allow the body to be relieved of the greater pressure acquired while working



Helmet and Telephone Attachments--Latest Equipment for Divers

in the denser atmosphere, or to establish, as nearly as possible an equilibrium between the pressure absorbed and the actual pressure of the water he may be resting in.

No diver should take any food for at least two hours before commencing operations. If any kind of refreshment be required, a biscuit, or dry cracker, with a small amount of fluid, or anything that will not excite the digestion, may be taken during work.

An eminent medical authority says: "The men who work subject to great pressures should not eat one ounce more of animal food than is needful to maintain their strength, as, in my opinion, should they eat too much, it increases the tendency to apoplexy. The bowels should be kept regular, as when they are unduly gorged they press upon the diaphragm, obstruct the action of the lungs and respiration, which leads to an embarrassed circulation of the blood and a whole series of evil results."

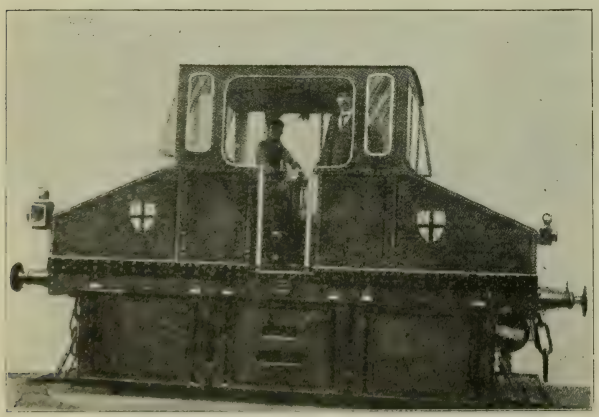
From an experience of many years, we have no doubt that diving is not injurious when conducted under ordinary precautions, and we have known of instances where divers, who in their youth were sickly, have become strong and well, which can only be attributed to the effect of compressed air upon their lungs, and the body in general, as absorbing a greater amount of oxygen from the compressed air. It also promotes digestion, owing to the greater quantity of oxygen carried into the blood.

Before a man attempts diving he should have a medical examination. Those who come under any of the following classifications should not undertake diving: Men with short necks; full blooded; who have headaches or are slightly deaf; who have spit blood or have palpitation of the heart; men with bloodshot eyes or high color in cheeks; men who are hard drinkers, or who have had rheumatism or sun stroke.

Thus we see the dangers found in this occupation are vastly more within the man himself than attacks from without by sharks and other monsters of the deep that we have been accustomed to read about.

Largest Gasoline Locomotive Ever Built

A gasoline locomotive is doing the work of a switching engine on a steam railway in London, England. Although in operation only a short time the work is pronounced very satisfactory, and as only one man is required to operate the machine, and the cost of fuel is less than for steam, the engine is effecting a large saving in money. On account of running in the city, the speed is geared down so it cannot exceed five miles an hour. The engine has three cylinders, each 9 by 9 inches, working at 450 revolutions per minute and develops 80 horsepower. This is sufficient to draw four loaded cars. The locomotive weighs 12 tons, has air brakes, and carries a fuel supply to last one day. The motor is cooled by fans.



Maudslay Petrol Locomotive

LEARN TO MAKE YOUR OWN FURNITURE.

That every householder may be his own furniture maker, if so minded, was declared proved by the South Park Workshop Association, Chicago, at a recent exhibition. Specimens of work done by members of the association consisted of nearly every article of household furniture. Exhibits of work done by children from 9 to 16 years old comprised school boxes, tools, plant stands, book shelves, etc. The association is supported by membership fees and maintains a workshop equipped with benches and tools for woodworking. Not only do business men gather at the shop, but their wives and children as well.

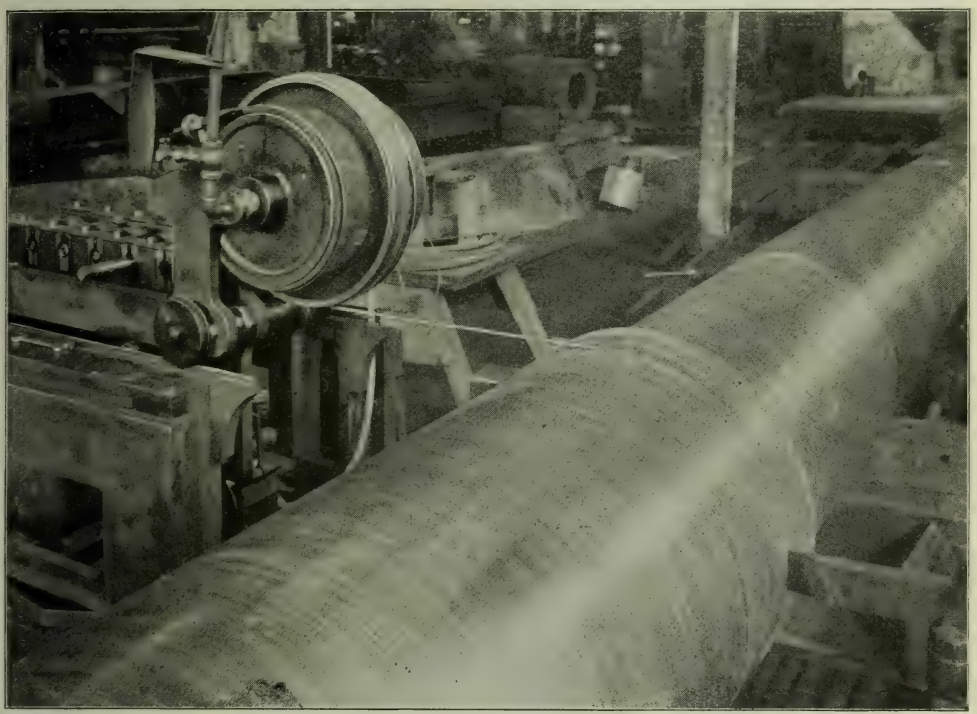
Future Gun May Shoot 100 Miles

New 6-Inch Type Will Pierce a Ship 30 Miles Away and Others Even More Powerful Will Be Built

A flash of fire; a sharp, loud report; a shot speeding through space at the enormous velocity of 3,500 feet a second; a hole bored through the steel side of a battleship 30 miles away. This is the work, experts say, can be done by the new 6-inch Brown wire tube gun that has just been built for the United States government. No gun like it was ever constructed before. It is the most powerful weapon of its size ever devised by skill of man. Think of it! A 6-inch gun which, if stationed at the Chicago harbor, would hurl a shot that would pierce a ship more than half way across Lake Michigan, or 30 miles away!

But this is probably but the beginning of a new era in gun manufacturing that may make the American gun more famous than the Krupp and that may prohibit any hostile ship from coming within 100 miles of our shore, for it is claimed that a larger type of this new gun will shoot 100 miles and larger types are to be made.

The 6-inch Brown gun has just been completed for a test at Sandy Hook. After its successful test, the national government will order made 24 more guns of the same size in addition to twenty-five 5-inch guns, there being $700,000 available for this purpose. The gun just completed is 26 feet long and weighs 20,000 pounds.

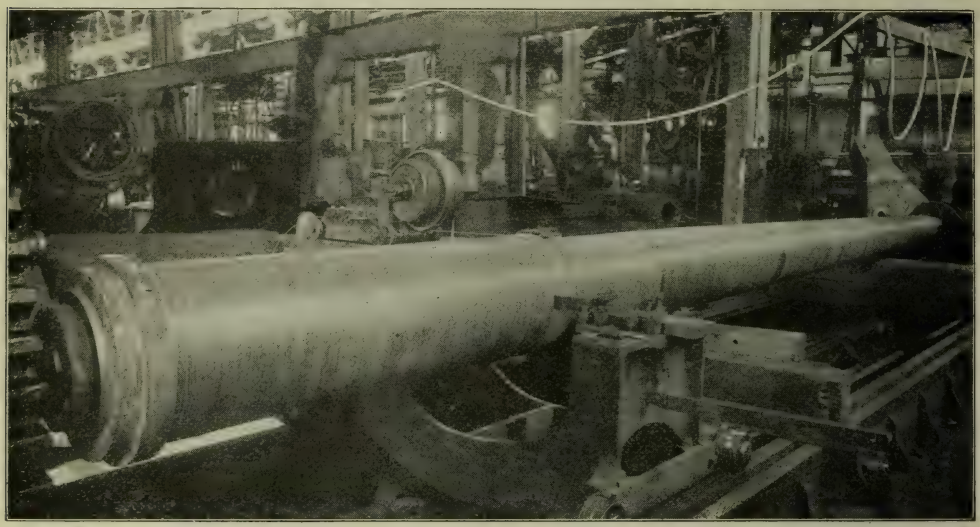


Winding 20 Miles of Steel Wire Into the New Wire Gun

One of the chief features of this great gun will be the obviating of the dangers from explosion which have so often occurred in the past history of warfare. The inventor claims that it will be impossible to explode this gun with gunpowder, no matter what the pressure. It is built to stand 50,000 pounds pressure to the square inch at the muzzle and 100,000 pounds to the square inch at the breech. Thus the muzzle strength of this gun is greater than

the breech strength of the guns now in use in the American army and navy.

The gun is built of rolled steel sheets upon which are wound layers of polished steel wire. The lining tube is of forged steel. Next comes the involute wire sheets.



Scene in the Reading Shops, Where the New Wire Gun Has Just Been Completed

Over the steel sheets more than 20 miles of square steel wire is wound. Over the wire is shrunk a trunnion jacket of forged steel. There are seven layers of wire at the muzzle and 21 at the breech. One of the accompanying photographs illustrates the manner in which this wire is wound by machinery. The tension in winding is about 128,000 pounds to the square inch. It is the tensile strength and elasticity of a gun built in this manner that gives to it great advantages over all other guns. The inventor of this gun is J. Hamilton Brown and the work is done at Reading, Pa. The manufacturer states:

"The possibilities of guns of this kind are marvelous. It is estimated, for instance, that a 10-inch gun will throw a shell nearly 60 miles and that a gun of larger size and of this pattern will throw a projectile 100 miles. All this is quite in contrast to guns made years ago and especially those used before the Civil War, when they were often made of a single piece of cast iron. While wire-wound guns are not altogether new, the Brown gun differs from all that have ever before been used in many important respects."

ALUMINUM USED FOR LETTERS AND FIGURES.

Aluminum letters and figures, light, durable, cheap and easily procured, are coming more and more into use, and are superseding brass in many instances where that metal was formerly used. For show window lettering they have qualities which commend them above letters of any other metal or material heretofore used. They do not easily tarnish, peel off, crack or break; they can be attached to almost every substance used, wood, brick, stone or metal, and if one should become broken, they are now of such general use, that it could be matched and replaced from the local market. These letters and figures are being used for street numbers, door plates, numbering machinery in large plants and in many other places.

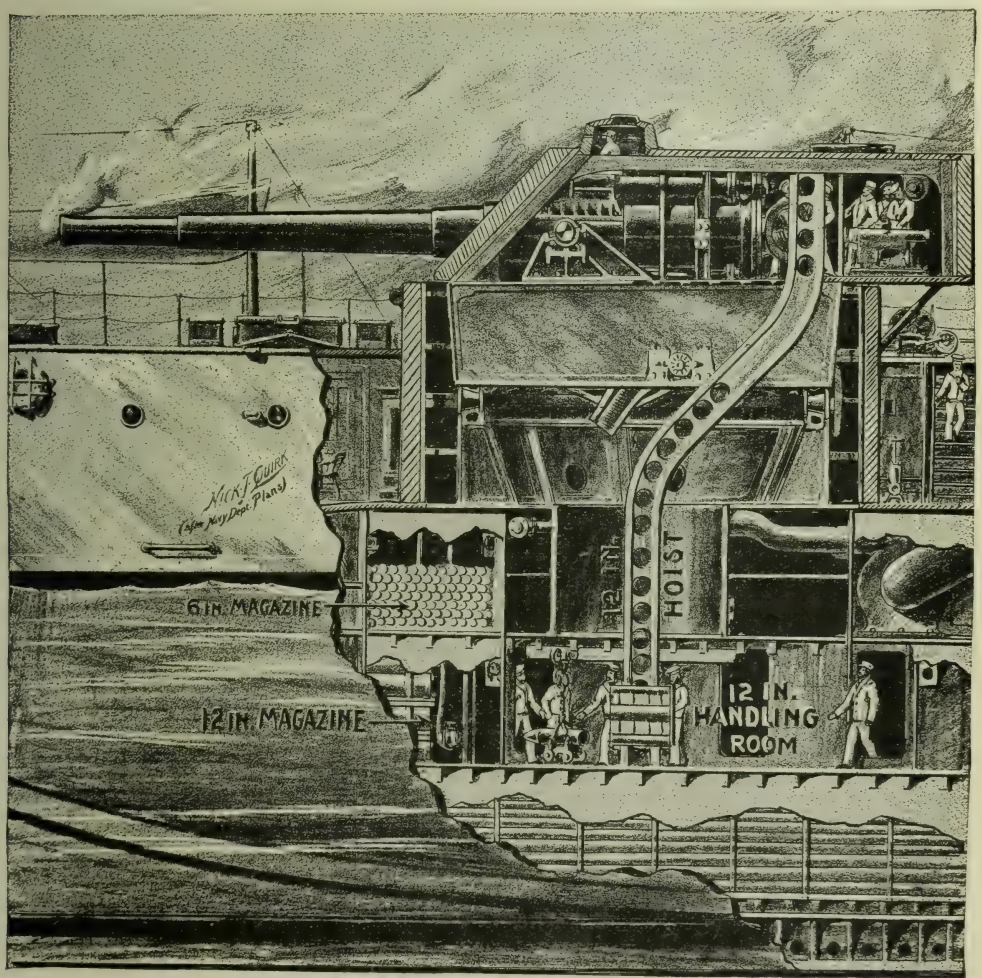
The aluminum supply is increasing, with a consequent reduction in price. It is so light that its volume per pound is three times that of steel. Its tensile strength for a given weight is 8,000 pounds greater than that of steel, or 78,000 pounds.

The total number of men under arms in the world is approximately 5,500,000, not counting reserves, marines and sailors in the navies. The total cost of the military and naval establishments of the world for one year is approximately $1,681,768,000.

The Lesson of the Missouri

Are Modern War Vessels as Dangerous to Their Own Men as They are to the Enemy? Is a Naval Victory Now as Dangerous to the Victor as to the Vanquished?

Another terrible naval accident has resulted in the death of 33 officers and men on the Missouri, America's newest battleship. It was caused by the explosion of 2,000 pounds of powder and is the fourth serious accident to guns of United States battleships in about a year. The news of the explosion was flashed over the world at about the same time that the British torpedo boat destroyer Teazer was wrecked by running into a sea wall at full speed and shortly after the British submarine "A 1" was sunk in Portsmouth harbor with its entire crew of eleven officers and men. The disasters to vessels in peaceful harbors seem almost as numerous as those in the belligerent waters where war is being waged between Russia and Japan.



Sectional View of the Battleship "Missouri" Showing the After Turret During the Loading and Firing of a 12-inch Gun---The Greatest Loss of Life Occurred in the Handling Room Where 1,600 Pounds of Powder were Exploded.

Such accidents and their frequent occurrence leads to the question: Are modern war vessels as dangerous to those operating them as they are to the enemy? Many can be found who will contend that they are. In fact most of the disasters that have befallen the Russian vessels have been self-inflicted. It has been often remarked that Russia has proved her own worst enemy and is about to defeat herself. Modern ships are seemingly about to prove inadequate to the strenuous duties demanded of them and the hazardous dangers they are forced to encounter from many sources.

The great loss of life occurred in the aft turret and the handling room during the loading and firing of a 12-inch gun. Four hundred pounds of powder exploded in the turret and 1,600 pounds in the handling room. Most of the dead were in the handling room, a compartment immediately underneath the turret where the powder charges are brought from the magazine and placed in the hoist to be sent to the turret. There is a stringent order issued by the navy department prohibiting more than one powder charge being in the turret at any one time; that is, until the gun has been fired and the breech block opened for the reception of the new charge, the latter could not be sent up from the handling room below. The construction of the Missouri, however, rendered this order nugatory. The floor of the turret of the Missouri is not solid but is merely a grating. The turret and the handling room, practically, formed a single compartment and, when the great burst of flames swept out from the breech of the gun and shriveled the men there like so many pieces of tissue paper, it found its natural vent through the grating and continued the work of destruction in the handling room.

What caused the powder to ignite, is the question that is puzzling the navy. Some say it was from the heat of the gun from rapid firing; some that it was caused by "back fire," which is supposed to be flame that hovers near the gun after the fire and then is blown back into the gun by a shift of the wind; many believe the accident was caused by the premature ignition of the powder charge by a fragment of the canvas bag, or by a grain of powder still smouldering when the new powder charge was rammed home.

The powder charge for a modern gun is encased in a canvas bag. When the gun is to be fired the shell is first put in and then the powder charge, 360 pounds for a 12-inch gun, in four bags of 90 pounds each. In the old days of the smooth-bore and breech-loader, which burned black powder, the gun was swabbed out to prevent any fragments from remaining in the gun when the new charge was put in. The modern theory is that in loading the shot, which fits closely to the bore, it drives everything before it, and, hence, that there is no danger of a fragment being left. Many officers, however, believe that the theory has not been absolutely established, and they think that a fragment of smouldering cloth could lodge behind the shell and would not be detected in the haste of loading and firing.

Americans hold the world's record for accuracy and rapidity of naval gun fire, but it is costing us dearly. The strain upon the nerves even during a practice of rapid firing, is most intense and of course, it would be much greater during an actual engagement. The accident to the Missouri has caused naval officers to discuss the effect of a naval battle under modern conditions and to await with keen interest reports that shall show whether the morale of the Russians and Japanese has been broken down by the tremendous strain upon their nerves. Many now contend that a naval engagement will be almost as disastrous to the victor as to the vanquished. The terrible shock of the impact of a 13-inch shell against the side of an ironclad even if it did not destroy the vessel, would cause such a terrific concussion and so affect every nerve that men would be inefficient when the reaction set in after the battle.

Crossing the Sahara in an automobile will be one of the interesting features of a 20,000-mile automobile trip around the world to be undertaken by Mr. Glidden of Boston. Two seasons are to be devoted to the trip, the party returning to Boston from Athens at the end of the first. Many of the great cities of the world are included in the route.

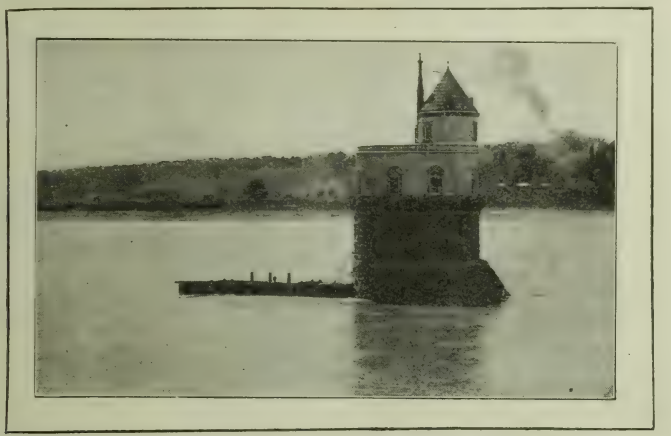
To relieve burns and scalds cover the injured place with cooking soda and lay wet cloths over it. Whites of eggs and linseed or olive oil; olive oil or linseed oil, plain, or mixed with chalk or whiting; sweet or olive oil and limewater are all good remedies.

The Interstate Commerce Commission report shows that 1,166 persons were killed by railroads in the United States during the three months of October, November and December last. Of these 175 were passengers and 991 employes.

St. Louis Water Problem Is Solved

World's Fair Visitors Find the Purest Water in a City Famed for Its Foul Drinking Supply

St. Louis' drinking water, long regarded as the muddiest and filthiest of any city of the civilized world, has been purified. The problem that has puzzled that city for generations and has caused scientists to fear the fate of other large cities with increasing population has been solved. Such a transformation has been worked that instead of having the foulest water in America, St. Louis can probably be said to now have the purest water in America.



St. Louis Water Intake Tower in the Mississippi River at the Chain of Rocks--Pumping and Settling Reservoirs in the Distance

Visitors to the opening of the Louisiana Purchase Exposition, who had long heard of St. Louis' muddy water so laden with disease germs, were amazed when they drank such clear, palatable water. This was the most wonderful and welcome exhibition the world's fair city had to offer its visitors. It is the most splendid possession it can give to its present and future inhabitants. Not only is this achievement an invaluable blessing to the present and future generations of St. Louis, but it heralds a new day in the purification of all drinking water.

And to whom is credit due for this accomplishment? Who is the hero who has saved so many hundreds of lives of the young and the aged, of the living and the unborn? Ben C. Adkins is his name. He is St. Louis' water commissioner. There is a man named Folk who gained worldwide renown for cleansing St. Louis' politics of its pollution. He saved the city's reputation. There is a man named Adkins who cleansed St. Louis' drinking water, fouler far than its politics. He has saved the city's lives. Let men revere them both, for the work of both has been great and noble.

Mr. Adkins' accomplishment is in every respect a most complete success, for not only has he given to the city drinking water that is absolutely pure, but in so doing he has not added to the burden of the taxpayers. His process is as simple as it is successful—so simple that it is a wonder St. Louis and other great cities had not thought of it before. But thus it is with all great discoveries and inventions. Mr. Adkins has given the city pure water at a cost of less than $2 per million gallons. Instead of a mammoth system of filtration plants costing many millions of dollars, such as has been proposed, and such as other cities have built, Mr. Adkins has purified the water, using the same plant with slight and inexpensive alterations. The system is a simple chemical and mechanical treatment which removes all the suspended matter and germs from the water. Sulphate of iron is the principal of the chemicals and a solution of lime is its sole assistant. The chemicals are obtained from the American Steel and Wire Company, which has rendered Mr. Adkins valuable assistance in his successful undertaking. Neither Mr. Adkins nor the American Steel and Wire Company has patented the process and it is free to the world as their gift to humanity.

Most unique is the action of the chemicals

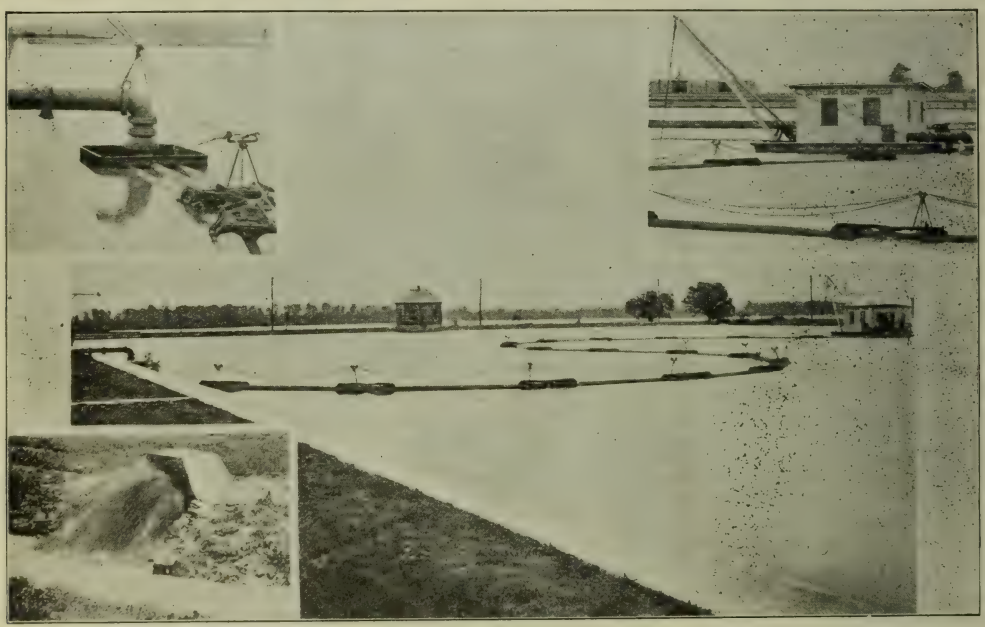
in ridding the water of its impurities. First the dissolved iron sulphate is injected into the suction conduit before it reaches the pump. The lime solution is injected after the water has passed the pumps. The reaction of these two chemicals is such as to combine with the carbonates in the raw water and unite the suspended matter into larger flocculent, gelatinous masses, which precipitate rapidly in the reservoirs. During this process the disease germs become entangled in these sticky, gelatinous masses and are carried to the bottoms of the basins and deposited with the sediment.

A very pretty illustration of this can be seen by taking a glass of dirty water, dropping into it a quantity of sulphate of iron equal to about two grains of wheat, then adding three or four drops of lime water and stirring freely for a few minutes. After standing a short period of time, these large gelatinous masses can be seen to form and precipitate, entangling in their sticky masses such germ life as may be found in the water.

The more germs and suspended matter there is to catch, the heavier the mass becomes and the quicker it is carried to the bottom. Thousands of cubic feet of this sediment is removed from the bottom of the reservoirs every few weeks, being readily flushed out through openings in the bottom of the basin leading to sewers.

At St. Louis the water works plant is arranged for the addition of filters. When completed, the water will pass from the reservoirs through sand filters; some of these light flocculent masses will be left in the water when it passes out of the reservoirs and will be used to form a coating over the top of filters and any remaining disease germs will be entangled in this gelatinous coating, which will remove the last vestige of these germs, and the work is then complete.

To demonstrate how the process plays havoc with the germs, tests have shown one cubic centimeter (about two drops) of raw Mississippi river water to contain 107,000 bacteria, practically all of which were removed in the thousands of gallons tested after the process of purification was completed.



New Hydraulic Dredge for Cleaning Settling Reservoirs.

No water can become so foul from sewage or other cause that the new process will not render it perfectly pure. The cities along the Mississippi and Missouri rivers may now send all the refuse they want to toward St. Louis without impairing the health of the Mound City's inhabitants.

Typhoid fever is caused by an intestinal germ called the bacillus colon, that comes

from the habitats of man, and is the most dreaded of all by physicians and chemists. This is the germ that has caused such horrible pestilence in the thickly populated cities of the world. This germ never appears in the wild woods or unsettled districts—it is only where people are numerous. The germs placed in water by nature are not injurious. Water of the Arizona, Nevada and Western Texas streams is healthful; but water flowing from big cities is dangerous. Filters will not destroy these germs, no matter how perfectly constructed they may be. The intestinal and other germs will follow water wherever it goes, unless entangled in a sticky substance as above described. If water can be forced through rock, the germs will go with it. The filter clarifies water, but does not rid it of germs. Hence the new chemical method would be of value to all cities and probably all will employ it in a short time. No germ can escape the myriads of little traps of the chemical process.

Noted scientists who have examined the iron and lime method have all acknowledged its unrivaled success.

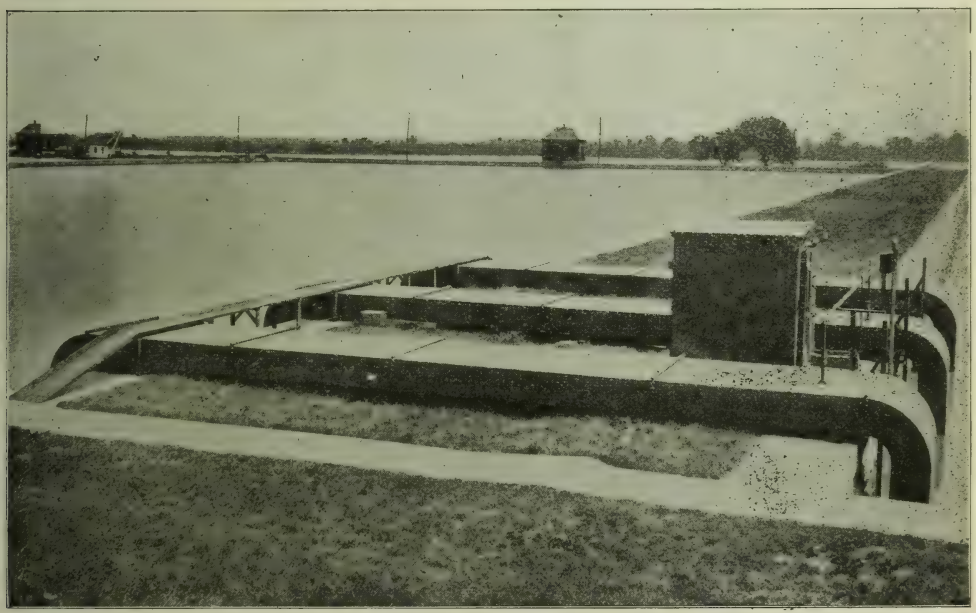
St. Louis, in pursuance of the new system, is preparing for the construction of a new chemical plant. Contracts have been let with the American Steel & Wire Company for 3,000 tons of sulphate of iron during the next year.

St. Louis preliminary success prepares the way for the establishment of a complete plant for sedimentation and filtration, which will undoubtedly be the most perfect water purifying system in the world and will metamorphose the conditions in the "Mound City."

Before the building of the hydraulic dredge system, the cleaning of the settling basins was done by emptying one basin at a time and washing the mud into the sewer by the aid of water siphoned from an adjoining basin and a large force of men with wooden scrapers, or with scrapers drawn by horses.

With the new settling basin dredge, shown in the illustration, the basins can be cleaned while in regular service. A centrifugal pump, electrically driven, is mounted upon a floating barge, and is provided with a suction pipe which extends to the bottom of the basin, and with a flexible floating discharge pipe which discharges over the side of the basin. The barge is 16 feet by 21 feet by 3 feet 9 inches deep and has a draft of about 26 inches.

The main pump is a 12-inch Morris centrifugal pump direct connected to a 90-horsepower motor. There is also a jet pump which furnishes a series of 13 jets at the mouth of the suction pipe by dislodging the mud. This is a 4-inch centrifugal



Great Settling Reservoirs of the St. St. Louis Water Works.

pump direct connected to a 20-horsepower motor. The suction pipe of the main pump is 12 inches in diameter and expands at its lower end into a flaring or fan-shaped mouth-piece, having an opening 10 feet wide and about 1½ inches high, and provided with rollers which rest on the concrete bottom.

The electric current for operating the various motors is generated at the Baden station, a distance of 4½ miles, and is led to the dredge through cables supported by floating pipes. The floating discharge pipe consists of 21 sections, each 21½ feet long, connected by 3½ feet of rubber hose. The discharge pipe proper is 14 inches in diameter and is supported by two floating air-tight pipes 12 inches in diameter, one on each side.

Although St. Louis' drinking water supply is obtained from the stream that flows between what are known as the banks of the Mississippi river, St. Louisans in reality drink Missouri river water and the Missouri river, by those who live along its course, bears the well earned pseudonym of the "Big Muddy." It is undoubtedly the muddiest, most turbid and treacherous stream in the United States. In its discontented, rapacious route it gathers up islands and banks, changing its bed many times in a decade, churning all into mud and hurrying it on to the Mississippi. The water that flows through the city pipes of St. Louis is pumped from a point four miles below the mouth of the Missouri river. Here anyone riding in a boat can plainly detect two separate streams of water flowing in the Mississippi's bed. One is dark as liquid mud and the other is fairly clear. The line that divides them is plainly discernible with the naked eye. One is the Missouri and one is the Mississippi; and it is from the muddy side of the river that St. Louis' drinking water is pumped. A pumping station, four miles below the mouth of the Missouri river, is at the Chain of Rocks, which is seven miles north of the Merchants bridge at St. Louis. The water is forced by pumps of 90,000,000 gallons capacity into a series of sedimentation basins, six in number, each basin being 19 feet deep, 600 feet long and

Old Method of Cleaning Mud From Bottom of Reservoirs by Horses and Manual Labor.

The total amount of sediment deposited in the basins in one year amounts to more than 363,000 cubic yards. Of this amount 255,000 cubic yards were removed by manual labor up to the time of the establishment of the new system, at a cost of $3,168.51, or 1¼ cents per cubic yard. The enormity of this amount of sediment can better be realized when it is called to mind that a cubic yard is an average wagon load.

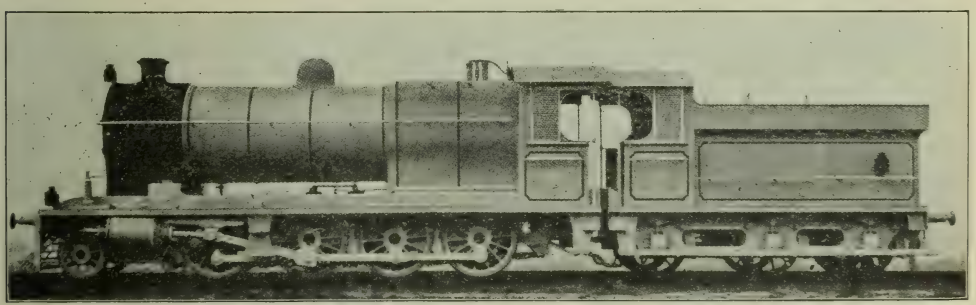
400 feet wide. It requires 48 hours for the water to pass through these basins and during that time the sedimentation is completed. The water goes in as muddy as the Missouri river and comes out as clear as crystal.

Extremely simple is this process in every detail and the cost is insignificant in comparison to other contrivances for purifying and clarifying water. Charged with both the sulphate of iron and the lime solutions, the water passes into the first sedimentation basin. Here the solutions quickly draw from the water by precipitation and coagulation the animal, vegetable and foreign matter, leaving but a small percentage to be extracted in its passage through the other basins and through the filter. When it shall have been completed, the chemicals form a coagulum, entangling the bacteria and suspended matter which are precipitated, and the subsequent rapid filtration of the water through sand will remove completely any remaining impurities. The sand used for this purpose is so selected that the component grains vary in size between certain optimum limits, determined by experiment. The river water normally contains more or less carbon dioxide, which holds in solution additional carbonate of lime. Thus the water is rather hard. Sufficient lime water must be added to neutralize the carbon dioxide and to unite with the iron of the ferrous sulphate. The iron is then precipitated together with whatever excess of carbonate of lime was present in the water. An increase in suspended matter obviously makes the coagulum heavier and it settles more completely in a given time. An examination of the iron contained in the water at the outlet of the basins showed that an increase in the amount applied to the raw water was not followed by a proportionate increase in the amount at the outlet, proving that the coagulant may be made to take the place of the suspended matter to a limited extent in the process of sedimentation. With turbid waters a purfiication of 98 to 99.8 per cent is obtained in the passage of the water through the first basin. On cleaning this basin after a period of from three to six weeks of high turbidity in the river, from 5,000 to 10,000 cubic feet of mud have been removed.

Observations on the occurrence of bacillus colon communis (disease germ) in the water further indicate the degree of pollution of the Mississippi river water by sewage. The typhoid germ is a normal inhabitant of the intestinal tract of man and also of many animals and occurs in large numbers in sewage. It is the opinion of sanitarians that the numbers of typhoid germs present within certain limits may be taken as an index of the degree of pollution. More typhoid germs occur in Mississippi river water than in any other prominent stream in America. In samples examined it was found that there were from one to 19 in a cubic centimeter (about two drops) of water.

Largest Engine in India

The largest engine on any of the 5-foot 6-inch gauge lines in India is a consolidation locomotive for service on the Bengal-Nagpur Railway. Its driving wheels are 4 feet 8 inches in diameter, its wheel base with tender is 48 feet; the boiler pressure is 180 pounds per square inch. The tubes have a heating surface of 2,062 square feet and the firebox 173 square feet, making a total heating surface of 2,235 square feet, while the locomotive's total weight is 150,080 pounds, or a little over 75 tons. The boiler has a copper firebox with copper stays and brass tubes. The reversing gear is placed under the boiler and is operated by a steam and water cataract cylinder.



Consolidation Engine for the Bengal-Nagpur Railway, India

Savings Bank That Cannot Fail

Largest Institution of the Kind in the World Conducted by the British Government

England's system of postoffice savings banks has prospered so phenomenally and met such a hearty response on the part of the public that the central institution, or general offices, in London has outgrown its big building in Queen street and moved to a colossal structure recently built in West Kensington. The new building covers five acres.

This is the biggest savings banking system in the world, although it is but a few years old. It is a bank that cannot fail, being part of the English government's postoffice system, and the public, knowing of its absolute security, has not been slow to tender its patronage. The people know that through this bank there is no danger of the hard earned savings of a life-time being swept away by some commercial misfortune, or through dishonesty of a banking official, conditions so common in America as scarcely to incite comment. The Englishman, when he puts his money in this bank, knows that he, or his heirs, will get it back with interest; no American possesses such assurance; he only hopes to get it back.

The general offices of this English savings bank employ 3,200 clerks. Since the system was inaugurated a few years ago the number of deposits annually has jumped from 3,000,000 to 15,000,000, the number of depositors from 2,000,000 to 9,000,000. In other words, on every business day 40,000 persons make deposits through 14,000 government substations. No wonder that, since the postal savings banks were established in England, nearly 500 private institutions of the kind have been forced out of business.

ICE-BOUND CAR FERRY BURNS.

Surrounded by miles of ice-bound waters, through which for several winters past she had been wont to force a way by means of a powerful ice-crusher, "Shenango No. 1," a large car ferry, 300 feet long, with a 54-foot beam, a height from keel to deck of about 60 feet and equipped with five engines, became the victim of flames and was utterly destroyed. The boat plied the 60 miles of Lake Erie's expanse between the harbor of Conneaut, Ohio, and Canadian ports, winter and summer, until the past winter when the 3,500 horsepower ice-crusher could not cope with the enthralled waters and she was laid up just off Conneaut, Ohio, where this spring she met the fate mentioned.

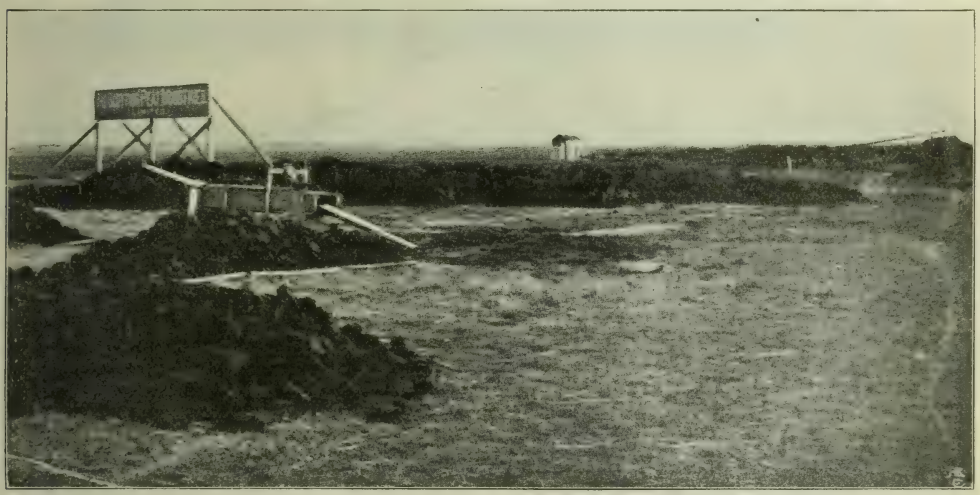
Burning of the "Shenango, No. 1," a Lake Erie Car Ferry.

This season two ferries will operate across the lake. One between Conneaut, Ohio, and Port Stanley carrying miscellaneous cargoes, and another between Conneaut and Rondeau.

Peat, The Fuel of The Future

Methods of Drying Perfected and Humanity is Destined to Become Independent of the Coal Trust

Two million eight hundred and thirty-one thousand unprofitable acres; one-seventh of the entire area of an impoverished country; serving no purpose but that of a single element in an eerie landscape over which the weird voices of many winds have moaned and soughed for thousands of years; a brooding silence broken only by the terrified cry of some animal, or of a human, as it is swallowed, engulfed to a fearful death, in the treacherous, oozing depths on which it has ventured too far. Waiting for ages and ages; waiting the development of human understanding—a culmination of man's ingenuity. Ireland's emancipation waiting at Ireland's door to be accepted.



Peat Moor Near Drumfries, Scotland, Where the Peat Industries are Being Developed

Sodden huts, too close to the shelter of domestic animals for thorough sanitation; half-clad children with bare, red feet. Food? No food, oftimes. A crude turf fire, a bed of straw, a broken chair, a pipe and a crucifix. Hopeless mutterings; the keening of mourners and the wail of the new born. A proud ship in the harbor and a disconsolate little band leaving the "old country" because she refuses her children sustenance.

Behold the transformation!

Two million eight hundred and thirty-one thousand profitable acres! Great plants installed upon the bogs, to which are trudging thousands of hopeful, happy sons of Erin. The joyful sounds of labor. Great electrically-driven excavators taking the peat from its bed, reducing it to small particles and spreading it out to dry; other machines to gather up the half-dried peat and yet others to press it into form, when it is ready to be sent out all over the world; ready, too, to burn on Irish hearths and to brighten Irish homes with the revenue it has brought. The life—the activity of a thousand and one interests, newly-awakened!

This is what the peat fuel industry is to do for Ireland. What it may mean to other countries can never be as much, although it amount to the same in dollars and cents. When we consider that Sweden prepares and uses 2,000,000 tons of peat briquettes annually; that Germany's peat supply is greater than her coal resource; that England, Scotland and Wales have a combined bog area of about 6,000,000 acres; that Russia produces 4,000,000 tons of the prepared fuel annually from about 2,144,000 acres of bog; that Canada's vast tracts are as yet unestimated; that in Alaska, where want of fuel has meant death to many, the supply is unlimited; that France has about 6,000,000,000 tons of crude peat; that the United States is almost as well supplied and that within 50 miles of Chicago there is enough peat to supply that city with fuel for 100 years, then does the future's promise begin to assume monstrous proportions and men begin to wonder and to speculate.

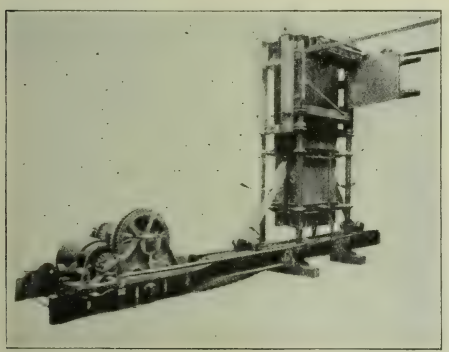
Peat, it is claimed, is coal in the process of formation. What now are peat bogs, will be, in centuries to come, vast coal beds, buried deep in the earth and only reached, even by the best of methods, after much hard labor. Coal, however, is carbonized wood, while peat has its origin in mosses and aquatic plants. Where these mosses and plants are in the more advanced stages of decomposition the peat is black, and where they are less decomposed, it is brown.

Showing Drying Racks and Peat Drying Plant in Canada

Machine for Making Peat Dust which is Used for Packing, Disinfecting and Antiseptic Purposes. The Fibres are Woven into Antiseptic Bandages, Horse Rugs and Clothing. Machine Produces 15 to 20 Tons of Dust per Day and Five Tons of Fibre.

It is a spongy substance, containing 80 per cent water, and of a consistency ranging from that of a bran paste to that of clay in the bank. It is permeated with fibres, or tubes, which absorb and hold water. This is the reason that process after process for drying peat has been tried and, almost without exception, has resulted in failure. Every principle applicable to the conditions has been tried; hydraulic pressure, centrifugal force, filtration, etc. None were effectual. When the eager inventor thought to force the water from the crude material by compressing it, the tough fibres and tubes expelled the water they contained but did not themselves crush or break. When the pressure was removed they took up what water remained in the peat, expanded, swelled to bursting, exploded and broke the blocks of half dried fuel. Thus was the inventor's object defeated. Finally, those experimenting with peat, realized that the only way was to pulverize the peat until its fibres were broken into small particles. But even when this point was gained, preparing peat after the old laborious methods was too tedious and too expensive to give it commercial value. Draining the bog by means of trenches, paring off its surface with spades, and cutting the peat out in oblong pieces, putting it out to dry, "turning" it, "footing," "stooking" and "stacking" it, this was the work that took a long while and must be done by hand labor. A great deal of money had been expended in making experiments and establishing plants, when Mr. Alexander Dobson, of Beaverton, Ontario, put into execution the first process that made peat fuel of commercial value. Like others, he had experienced many difficulties, but persistency and faith in peat as the coming fuel were finally rewarded by success. The

output of methods formerly employed for cutting peat from the bog was not great enough to keep a press running. This difficulty was overcome by the invention of an electrically-driven excavator and spreader. This machine digs the peat, pulverizes it and spreads it over the surface of the bed in broken particles. Sun and air do their part, evaporation of moisture on a fair summer's day being rapid, and when the electrical gatherer collects it, the moisture is reduced from about 85 per cent to as low as 35 per cent. From the gatherer it is dumped in a windrow beside the tramway, whence it is conveyed by an electric tram car to the factory and there disintegrated—ground so fine it can be handled by the press. Then it is conveyed to a rotary drier and the moisture is there reduced to about 10 per cent. The last process is that in which the peat passes through the press, coming out in the form of briquettes 2½ inches in diameter and 2⅛ inches thick. Very little at-



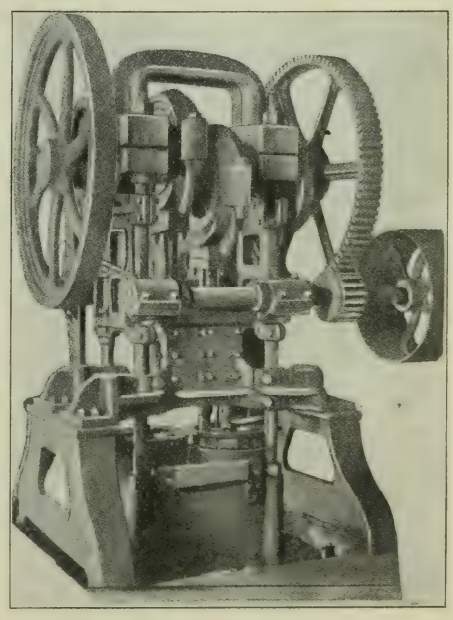
Peat Press of Messrs. Webster and Bickerton, of Goole, Scotland

tendance is required for this continuous process, the power plant requires the care of one man, and another keeps the machinery and fires of the rotary drier adjusted so that the moisture is kept at the proper percentage. The peat press is almost frictionless,—friction of the peat against the walls of the dies being prevented by oiling each die before recharging. Each briquette remains in its die six seconds and then follows the compression from another block being formed on top of it; six seconds later it is expelled and the second block succeeds it. Each machine is fitted with two punches having a die block containing eight dies. The base block against which the briquettes are formed is rigidly fixed, excess strain or pressure being counteracted by springs on which it

Peat Briquettes

rests. Two heavy eccentrics faced with roller bearings impart the down thrust of the punches, turning the die block through one-eighth of a revolution. In the die next to the compressing punch works the releasing punch which expels the finished briquette, and a third die receives an oil swab which oils the inside of the die with crude petroleum—helping to overcome friction in expelling the briquettes.

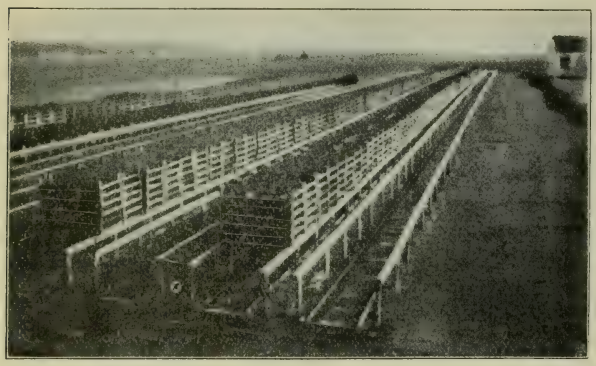
A 5-foot gear wheel operates the eccentric shaft, receiving its power through belting run to a pulley on the pinion shaft. Each shaft has a heavy fly-wheel for steadying the machine. Every minute 50 revolutions are made, the two punch systems acting reciprocally and the heavy briquette-forming pressure being exerted



Dobson Patent Peat Press

twice in each revolution, thus turning out 100 briquettes, weighing 40 pounds, per minute, or in other terms, a rate of one ton in 50 minutes.

This is the Dobson method, successful and practicable. Nevertheless, inventive genius has not stopped here. A recent method



Open Air Drying Racks at the Works of the Scotland Peat Industries

promises even more for the peat fuel industry. In this new process the peat is excavated from the bog by machinery and conveyed directly to the plant without the long delay of air drying. Here it is packed into rotary cylinders which are revolved at great speed, the peat being beaten by an interior beating device while the cylinders rotate The centrifugal force expels the moisture so that it is a very low precentage. Then, by means of electrodes connected by conductors with a dynamo, the centrifugally-dried peat is included in an electric circuit; the resistance of the peat generates heat and it is carbonized. A mass of black globules represents the results and retains all the valuable properties of the raw material. It then passes to kneading machines and after being well kneaded it is either molded into briquettes, or left to dry and harden, in which latter case it is afterwards broken, screened and graded.

As has been stated, the value of this process lies greatly in the fact that in climates where the drying season is short it can be prepared despite the weather conditions. In Alaska a supply could hardly be prepared after other methods, and what a boon prepared peat fuel would be in that climate! It is a fact that the peat supply increases proportionately with the distance from the equator and, under the eternal law of compensation, there must be some means by which it can be utilized in those cold countries where it abounds. Again, in the electrical process, there is no loss, no escaping of valuable elements in the form of gases. One ton can be produced at the almost incredible cost of $1.21.

Prepared peat is an almost smokeless fuel. It burns to the last vestige, leaves a clean, white ash and no clinker.

Peat has been experimented with for many other purposes than fuel. A concern at Celbridge (near Dublin) on the Liffey, is manufacturing "ochre glazed" wrapping paper from it with success. Other uses are being inquired into. No life exists in peat, therefore it must be a good disinfectant. Peat moss litter is manufactured on a large scale in Scotland. Peat bricks, peat cement, peat fabrics, peat soap—all these are industrial items yet to be developed.

If, as is claimed, peat is incipient coal, the question may arise: Do we rob posterity when we consume both coal and coal in process of formation? Modern demands will never heed the question concerning so great a factor so easily obtained. But no matter! Peat one foot thick over one acre will make 300 tons of briquettes. There is enough to last until the millennium and then, probably posterity will not need it.

STEAM VESSEL TO CRUSH WAY TO NORTH POLE.

When Lieutenant Peary makes his next expedition to the North Pole, steam, instead of sails, will provide motive power. With this innovation it is expected that the "Charles H. Darling," a wooden-hulled vessel provided with powerful machinery, will be able to force a way through the ice.

Matthew Hansen, a colored man who has accompanied the explorer on all previous expeditions, will be with him on this trip, his qualities of bravery and good marksmanship placing him high in Lieutenant Peary's esteem.

The Zambezi river, at a point just below the magnificent Victoria Falls, is being spanned by a bridge 30 feet wide and carrying two railroad tracks. The bridge will be suspended 420 feet above the waters of the river.

Would you like to visit the St. Louis World's Fair? Earn the trip. Write to Popular Mechanics for particulars.

Future of the Submarine

Author of the Nautilus Says Its Use Will Be Confined to War and It Will Bring Peace

By Jules Verne

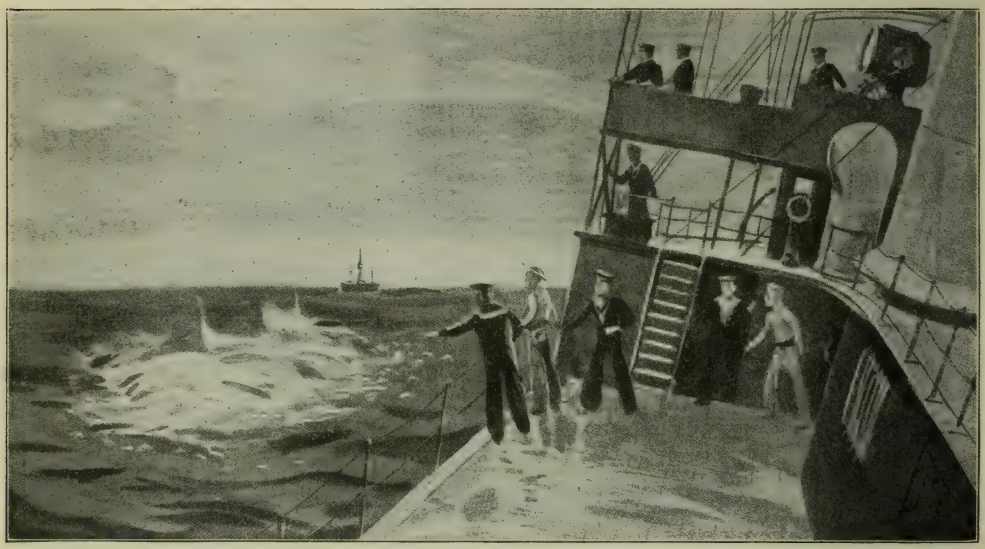
For some inexplicable reason many people insist upon regarding me as the inventor, or the imaginer, of the submarine. I am not in any way the inventor of submarine navigation, and reference to the authorities will show that many years—fully fifty, I should say, before I wrote about the Nautilus—the Italians were at work upon submarine war vessels, and other nations were busied with them, too. All that I did was to avail myself of the great privileges of the fiction writer, spring over every scientific difficulty with fancy's seven-leagued boots, and create on paper what other men were planning out in steel and other metals.

First Test of Submarines in a Gale.—Portsmouth Flotilla Navigating the Surface in a Wild Sea

The future of the submarine, as I regard it—and let me here disclaim all gift of prophecy—is to be wholly a war future. The Nautilus, as I have written of it, will never be, I think, an actual fact, and I do not believe that under-sea ships will be built in future years to carry traffic across the ocean's bed to America and to Australia. Even if the air difficulty were successfully encountered (and I have my grave doubts as to the possibility of that), what would be gained by any such sub-ocean traffic except freedom from sea-sickness? No submarine would ever cross the bed of the Atlantic faster than a ship upon the waves would traverse it, and surely freedom from that bugbear is not a sufficient incentive for the creation of a Cunard line beneath the sea.

I am an old man now, and working, as well as my deficient eyesight will allow me, upon my one hundred and second volume of boys' stories, and as I look back on the years which have passed since I first wrote the life-story of the Nautilus, and of its owner, I see no progress in the submarine which makes me hope for its use as a commercial medium. It has been wonderfully improved, I grant you—miraculously improved almost—but the improvements have all tended to one point—its efficacy as a war weapon; and that will be its one use in the future, I believe. I even think that in the distant future the submarine may be the cause of bringing battle to a stoppage

altogether, for fleets will become useless, and as other war material continues to improve, war will become impossible. As time goes on, each nation will acquire a large and very rapid fleet of submarines. Each little vessel (I am inclined to think that in the future they will be smaller than they are today, and manned by one or two men only) will be absolutely in control, and will be able with scientific accuracy to place torpedoes underneath the greatest vessels, and to blow those vessels up. I do not think that any apparatus will be found to counteract the intense rapidity and certainty of the submarine, and eventually, when every nation has its fleet of hundreds of these little vessels, what is to war with them? They may be able even to blow up huge tracts of country, and retreat unseen, some day; who knows?



The End of a Submarine—Air Bubbles Rising to the Surface Showed the Location of the "A 1" of England Which Sank with All on Board

Submarine Torpedo Boats Rising to Surface to Claim Theoretical Destruction of a Battleship

Of course, before these things can be, improvements in the submarine will have to be manifold, and almost as wonderfully ingenious as the beginnings of this greatest wonder of man's science; but these things will, I think, be possible.

I followed very carefully the experiments made lately during the French maneuvers in the Mediterranean, and during the maneuvers of the English fleet, and I was very much struck by the accuracy with which the submarines of both fleets managed to slip in, strike, and get away in safety.

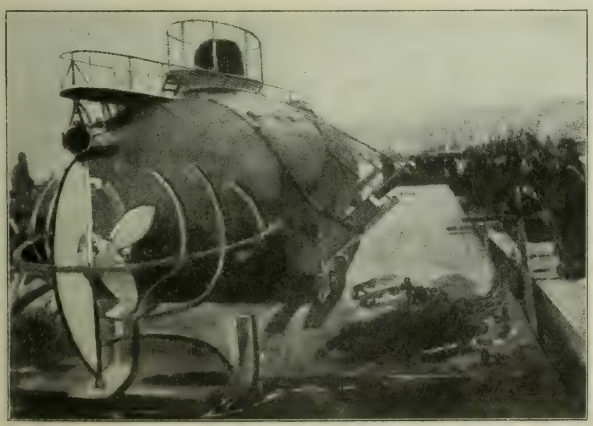
Imagine hundreds of these vessels with their deadly freight. Can you suggest that any means would counteract their deadly power? I do not think so. The refraction of the water, the depths to which the submarine can sink, its freedom from all observation—all these things make it the deadliest of war inventions, and in future years, when I myself am under ground, these powers will be enhanced. I do not think that

apparatus will be found to render them more harmless. The sea is hard to pierce, and I can think of nothing, even upon paper, which will enable men on board the supermare vessels to trace the tracks of their deadly little foes beneath the waves.

But as a commercial item in the world's civilization, I do not thing that submarines have any future. Air may be found for them, but even so it will never be found plentifully enough to make it possible for a large number of passengers to travel for a length of time in comfort. Electricity for their propulsion may, one day, be gathered from the sea itself, but I have doubts of it; and even if these things were done, the pressure of the sea at any depth would crush a submarine to fragments, unless some hitherto unheard-of metal were discovered which would withstand the pressure. Think of the size a trans-Atlantic submarine would have to be, and think how slowly it must travel, owing to the pressure of the waters round it, and tell me if you think a Majestic will ever be made to travel to New York upon the sea bottom.

I doubt it—doubt it very gravely; and, as I have said, I do not see that there is any need for submarine trans-ocean vessels. But submarine fleets are in the near future and they will, I believe, prove the thin end of the beneficent wedge which will cause war to cease between the nations, owing to their very deadliness. Unfortunately their work will not be done in my time. I am a man of peace and should have loved to see it, but it seems that my fading eyes are destined to behold sickening carnage in the unequal contest of the improved submarine machine with the heavy battleship, whose days are numbered.

War Vessel With Nets Out—The Battleship's Only Protection Against Torpedoes.



Submarine Launched from an Ice Platform at Vladivostock

LONG VOYAGE OF TORPEDO FLOTILLA.

Five torpedo boat destroyers, comprising the first torpedo flotilla of the United States navy, after a trip of over 18,000 miles, arrived at the Philippine Islands on April 1 in good condition. The torpedo flotilla went to join the Asiatic fleet, leaving Hampton Roads December 12 and arriving at the Islands April 14, a trip of 124 days, 54 of which were spent in port as the quarters on board the destroyers were cramped.

The trip clearly demonstrates the superiority and seaworthiness of these United States craft—the smallest perhaps that ever made such a voyage with so few incidents of moment. The little vessels are each 245 feet long, 420 tons displacement, 8,000 horsepower and have a maximnm speed of 30 knots an hour. The service their crews render is of high grade, both in seamanship and accuracy of torpedo fire. The expedition was under command of Lieut. Lloyd Chandler, who has expressed himself confident that the boats can go to Hades and back.

Popular Mechanics

A MONTHLY MAGAZINE

"Written so You Can Understand It"

PUBLISHED BY POPULAR MECHANICS CO.
Journal Building Chicago, Illinois

SUBSCRIPTION

United States, Canada, Mexico and all U. S. Possessions, per year, - - - - $1.00
Foreign Countries, post paid, - - - 1.50

Make Remittances by Draft, Money Order, or Registered Letter. Address

POPULAR MECHANICS
JOURNAL BUILDING, : : : CHICAGO

LONG DISTANCE TELEPHONE MAIN 2682

Entered at Chicago Postoffice as mail matter of the Second Class

ELECTRICITY—WHAT IS IT?

By Jay G. Wait.

At the present time we understand a great deal about how to generate and control this subtle element or force—but as yet there has been no theory advanced to explain satisfactorily what it is.

The following theory may clear the matter up—or at least aid in doing so, and for this reason it is given:

A few days ago the papers reported that an inventor had discovered a method by which the music of the spheres or stars could be heard, and it was stated that a ray of light from Sirius or any of the fixed stars, striking upon a disk would make a musical tone which could be heard by the person using the inventor's machine, but that the rays of light from the sun produced jarring or discordant notes.

The point which arrested my attention in this is that it seems that a ray of light—a single ray—is separated out, and that it has force—for it strikes the disk, and makes a vibration producing musical tones. My theory is that the sun is an electrical sphere and not a solid or fluid mass of matter burning itself up, and that it takes as much from the universe as it gives, thus preserving a balance. The rays it sends out are positive electricity and as one motion must create another, the reverse motion is negative electric ether which, when it reaches the sun, is changed to positive, and sent out again. This electric sphere is so large that if its center were located at the earth's, its outer circumference would reach over 200,000 miles beyond the moon and in the other direction 400,000 miles, for its diameter is over 800,000 miles. It is so far away that it looks about the size of a large plate or half bushel, and its rays of electricity or light travel at the rate of 95,000,000 miles in five minutes. These rays of light are intensely hot, and striking upon the surface of the water at the equator, produce an evaporation which makes the atmosphere in which the earth circles and moves.

The rays of light from the sun striking our atmosphere are retarded—there is friction which creates electricity—and so the earth is surrounded by electricity which nourishes plant and all life.

When the earth has turned on its axis and the "sun is down"—we have darkness and less electricity, which no doubt induces or causes sleep.

Lord Kelvin photographed electricity—or rather its motion—which he found to be circular, or wheel-shaped. The definition of heat is not the absence of cold as it used to be, but it is said to be a mode of motion. In the liberaion of the gases in coal, motion is produced which we sense as heat. Other modes of motion we sense as sound and light.

Now it is very evident that when we telephone to a friend hundreds of miles away—that the vibrations are not carried through the wire, but that the batteries draw around the wire electric ether, which carries the vibrations thousands of miles per second, and we find that the wireless messages go through the air much more freely when sent from elevated towers or poles, than in the denser medium close to the earth.

The earth is surrounded by electricity, both positive and negative, which is sent here by the electric center—the sun—and in a few years we will know how to utilize the rays of the sun to generate this element so that its cost will be but nominal.

If heat is a mode of motion generated by atoms of matter changing place and form, electricity must be the same, for heat, light and electricity are very similar, and so we may say that it is etheric matter in a high-grade cassiterite.

The Chicago patent association is urging legislation appealing the present court practice of refusing injunctions asked against the infringement of patents on the ground that the validity of the patent had not been previously established by the courts. This practice, it is declared, cuts at least eight years from the life of every patent granted.

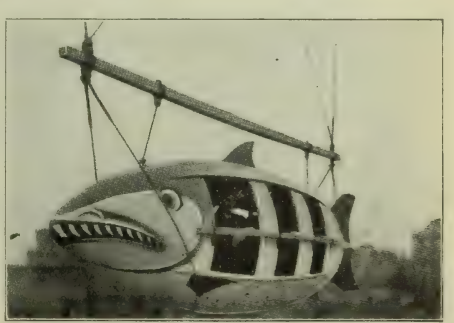
Newest Sports of the Thrilling Kind

Sir Hiram Maxim's Revolving Umbrella and a New Loop the Loop Will Please the Lovers of Poignant Physical Sensations

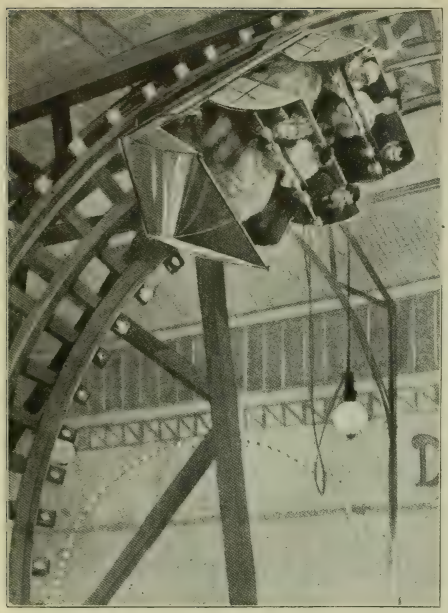
How would you like to be spun around, at the speed of 60 miles an hour, in a car hanging to the rib of a giant umbrella which is 200 feet in diameter? That is the amusement of the future and its thrills you may soon experience for it is coming to America. The device is called the "umbrella flying machine," and is the invention of the noted Sir Hiram Maxim of aeronautical fame. The "umbrella" made its appearance a short time ago at West Norwood, England, and is soon to be seen at the Earl's Court and at the Crystal Palace, London. It is a roundabout in which the revolving bodies are suspended. High in air and hanging round the rim by steel wire ropes are cars, quaintly shaped and painted like fish. The cars generally hold four people each. They are boarded by the passengers from a platform encircling the outer central pavillion, when the "umbrella" is "closed." At this time the umbrella is 66 feet in diameter and 200 feet in circumference. As soon as the cars are all occupied the signal is given and the umbrella begins to open and circle around at the same time. Faster and faster it goes and wider and wider the umbrella opens and the cars fly out farther and farther until, instead of describing a circle 66 feet in diameter and 200 feet in circumference, they are speeding round a circle 200 feet in diameter and more than 600 feet in circumference.

Sir Hiram Maxim's Revolving Umbrella

Below the platform by which the people mount the cars is a powerful engine which furnishes the power for rotating the "umbrella." This device probably is destined to supersede the "loop the loop," the "shoot the chutes," the "Ferris wheel," and other such thrilling amusements so popular in American cities.



Car of the "Umbrella"



Looping the Loop in Paris

But there is a new method of "looping-the-loop" which has appeared in Paris and Chicago, that may add still more zest to that exciting feat. The looping apparatus shown in the picture is now located at the Pole Nord, Rue de Clichy, Paris, and at Sans Souci Park, Chicago. It differs from the former "loops" only in that the loop is larger and the cars go faster. They are provided with an angular wind shield in front to lessen the friction as much as possible while the car is making its rapid turn and while the occupants are riding with their heads down. The apparatus is about 166 feet in total length. The platform upon which the track is fixed is 33 feet wide and its extension is nearly 290 feet. The point of departure is raised 48 feet above the point of course, while at the terminal it is raised 26 feet. The loop itself is formed as is usual of a spiral helix, the height of which is 36 feet and the diameter 26 feet. The light little car which tears along the track has two seats and can hold six passengers. The loopers are taken up to the platform by an electric elevator. As soon as they are securely seated the car is given a light push and it at once starts off, negotiating a plane inclined to 45 degrees. In four seconds, during which 83 feet have been traversed, a speed of nearly 40 miles is reached. Centrifugal force is the power that holds the car on its tracks.

SCALE TESTING CAR.

A car for testing scales is being used on the Illinois Central R. R. The car is of steel construction and is loaded with 50-pound United States standard test weights to the amount of 20,000 pounds, the gross weight of the car being 61,000 pounds. When run upon the scales, if a weight greater or less than 61,000 pounds is shown, the scales are not accurate. Track scales are tested twice a year and all other scales at least once a year. The Railway and Engineering Review says the work costs the company about $600 per year, but is well worth its cost of maintenance.

MECHANICS FOR YOUNG AMERICA

Things a Boy Can Make Out of Old Bicycle Parts

There are many things a boy can make out of parts of old bicycles, which he can either sell at a good profit, or can use for his own pleasure. Second-hand bicycles can be purchased for $3.00 or $4.00 and the ingenious boy can realize twice as much more on them.

A hat rack may be fitted up like Fig. 1. This involves, first the employment of three parts of tubes, about 10 inches long, soldered into a disk as at B, fitting the main part A. This main part is simply the cycle handle bar and steering shaft. The stand is coated with black varnish and the bars and shaft polished. The stand will sell for $1.50.

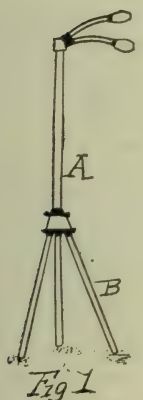


Fig 1

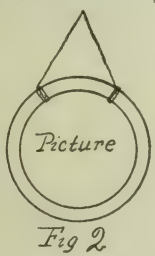


Fig 2

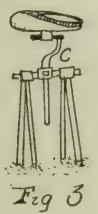


Fig 3

Rip the tires off the wheels and stuff them with curled hair and then clean and furnish them with wire supporting arrangements as represented in Fig. 2. Fit a disk of tin into the circle for a back. The two tires may be sold for 75 cents each for picture frames. The seat may be utilized as in Fig. 3 and a little hall or nursery stool results. The saddle with bar is simply set into the union of four pieces of tubing, each tubing being about 10 inches high. The connecting part is at C, which is adjustable, so that the height of the saddle can be regulated. These sell for $1.00 each. The frame brings another dollar when merely cleaned and repainted and fitted with a little wire to hold it upon the wall, with some sort of an inscription, on a walnut or sheetmetal background as shown.

Every part of the frame may be used in some way. Fig. 5 is a cluster of tool handles and parts made from tubes and joints. D shows a part provided with plug in the tee and into this plug is driven the

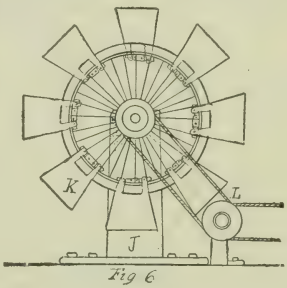


Fig 6

Fig 4

head of the punching tool required, this framing an awl or similar tool. E is a straight tube into which a hardwood mandrel is driven and there is a furrow on this mandrel and a shaft is inserted for screw driver or chisel. F is a little tube carrier, made with two sections of tube, one fitting within the other and either end closed with soldered disks. This is for holding tacks,

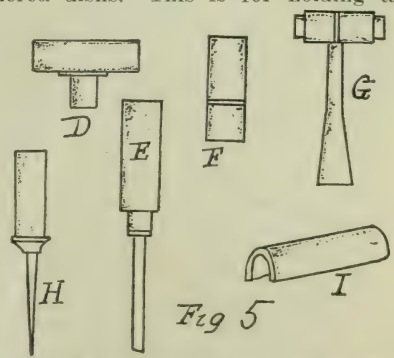


Fig 5

etc. G is a mallet-like tool, with the tube portion sustaining the wood or lead plugs for "soft" work. H is a prick tool made

of handle tubing, and the tubing is fitted with a flange and solidified with babbitt metal run in, or with hardwood plug. I is a half tube, used for miscellaneous purposes about a shop. By the use of these various parts of wheels boys can derive about $14 for each wheel, costing originally three or four dollars.

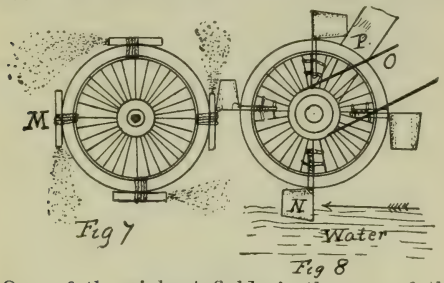


Fig 7 Fig 8

One of the richest fields is the use of the wheels of bicycles for mechanical devices. Fig. 6 is a windmill affair made with tin wings, the feet of which are split as shown, and one side of the tin is placed on one side of the tire and rim and the other on the other, and the two bolted on the inner side. The wheel is placed in a shaft bearing so as to revolve on a stand J. The wheel wing is marked K. At L is a wheel which is of wood and is grooved and arranged to guide the rope belt from the similarly grooved wheel on the driving wheel to the wheel L and onward to the mechanism to be driven. The wind plays against the wheel wings and the wheel is revolved.

A fireworks wheel is shown in Fig. 7, consisting of taking the wheel complete as in the windmill case and fitting the fireworks

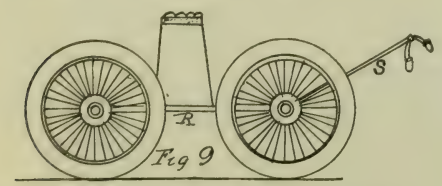
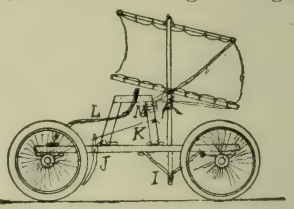


Fig 9

cylinders M by wires. These rockets or fuses, when lighted, cause the wheel to revolve as a pin-wheel is turned, and the display is quite effective. A model of a cycle wheel is fitted up as in Fig. 8, with the wheel arranged to turn on its bearings, the latter fitting into a wood projection P. This projection allows the wheel dippers to reach the flow of water. The dippers are ordinary kinds, and are wired to the spokes as shown. The flow of water forces itself against the dipper as at N turning the wheel. A pulley which is grooved is fitted to the shaft to drive the belt O, and this belt runs to the device to be operated. Vehicles for freightage purposes form a part of the cycle part construction shop trade. Fig. 9 illustrates one of the altered contrivances. Four wheels are selected and axles adjusted and a body placed thereupon, marked R. On this body, which is of wood, is the box seat. The handle bars and shaft are arranged to join on to the fore axle as at S, and this is the means by which the affair is hauled.

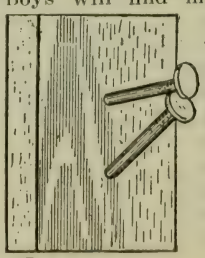
HOW TO MAKE A WIND PROPELLER.

A wind propeller may be constructed with four old bicycle wheels arranged with shafts pretty much like the shafts of a hand-propelled cart. The platform is flatter, however, and the body one tier so that it is lower. A framework of wood is built at M and this is a support for several purposes. The sail is secured to the mast which is fixed into the body of the cart as shown. The sail is linen fabric. There are two crosspieces to aid in keeping the sail properly opened. The steering arrangement is



through the rear shaft. The shaft is pivoted as in a hand-propelled cart, and the rod I extends from the middle connection of the shaft up to a point where the person seated on the wooden frame can handle it. There is a brake arranged by making a looped piece J and hinging it as shown. This piece is metal, fitted with a leather face. The cord K is pulled to press the brake. I marks the support for the mast underneath the body of the cart. In a steady breeze this cart spins nicely along the roads.

TO HANG HEAVY THINGS ON A NAIL.

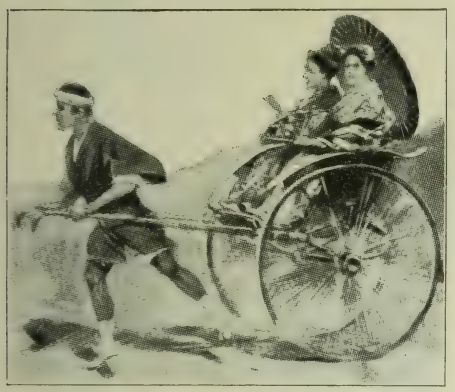


Boys will find many places around the house, where a hook to hang things on will be a great convenience. Instead of buying hooks use wire nails, and if driven as shown in the cut, they will support very heavy weights. Drive the lower nail first.

THE NATIVE VEHICLE OF JAPAN.

Tokio Society Rides in a "Jinricksha," Drawn by a Man Instead of a Horse

War has not checked all the pleasure pursuits and gaiety of Japan. A favorite amusement of the wealthy young women



Human Horses in Japan

of Tokio is riding in their native two-wheeled vehicle pulled by a Japanese instead of a horse. The motive power in this contrivance is known in Japan as a Jinricksha-Man, and the vehicle is called a Jinricksha. These pleasures are not the Japanese woman's after she marries, however. Americans would call the Japanese Mormons, for each of them has many wives and after the Japanese girl marries she is allowed few privileges. She is made to blacken her teeth, pull out her eyebrows and make herself as ugly as possible so that no other man will be attracted by her. The women shown in the Jinricksha are not married.

AUTOBOATS BECOMING POPULAR.

Autoboats are attracting the attention of automobile devotees to an extent which threatens to make the autoboat the more popular of the two. Many prominent persons attended the recent autoboat races at Monte Carlo, where the enthusiasm over the autoboat is great. To maintain great speed, motors of a high power have been used on little boats, this practice is dangerous, however. The autoboat is destined to be popular with a large class who care nothing for automobiles, but delight in water sports.

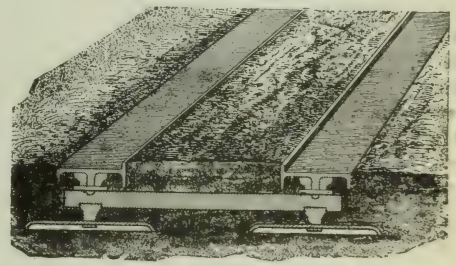
SHIELDED FLEXIBLE CONTACT FOR USE IN CAR HOUSES.

A flexible overhead contact for use in car houses where the cars are moved by means of their motors is described by the Street Railway Review. A loose, flexible contact is attached to an over-running trolley carried on an overhead conductor. The end of the connection is bare and hook-

shaped so it can be placed against the bare shoe support. Over the hooked end is a wooden cylindrical shield which covers the bare wire when not in use and can be moved back to leave the contact free for use. This protects the workmen from accident by coming in contact with the bare wire.

STEEL TRACK HIGHWAYS.

There are those who believe the time will come when hundreds of thousands of miles of our country highways will be laid with steel track for the use of wagons and carriages. When that time does come, we may safely predict the wagons will not be drawn by horses and mules to any great extent—they will be motor wagons. The illustration herewith is interesting, however, as having demonstrated the great advantage of hauling over steel rails, or plates, instead of on the best macadam road. On the steel



Steel Track Highway

track roadway one horse in a light harness was able to draw with ease a load of 11 tons, which same load on a common road required 20 horses to pull.

The expense per mile of building such a road as illustrated is as follows: rails and accessories, $4,000; digging trench and laying track, $600; broken stone, labor, rolling same, $1,100; total, $5,700.

Lathe Attachments

Copyrighted 1904 by W. W. Wood

GEAR WHEELS AND ROTARY CUTTERS.

In taking up the subject of Gearing it is not the intention to go into the theoretical part, but to show a simple method whereby the amateur may be enabled to calculate and make the gears for use in his models, etc.

In practice gears are cut on special and complicated machines made for that purpose only and there are many different kinds of gears, but only such as may be cut on a small lathe, with apparatus heretofore described, will be referred to.

Gearing is a means of transmitting motion in machinery by the use of toothed wheels. Frictional gears have no teeth, the one gear, to which rotary motion is imparted, driving the other by means of friction alone. This would be a very convenient means of gearing, if there were no slip to contend with, and is often used for special purposes, but, where a positive motion is necessary, teeth are added working one within the other. These teeth are so designed that the proper clearance may be had at each moment of rotation, otherwise they would bind and stop the machinery or break.

There is a line existing geometrically in all gears called the pitch circle, or pitch line, which is the circumference of the cylinders or blanks without teeth and is, in practice, a little less than one-half the depth of the tooth. The distance measured along this line of a tooth and a space, or from the center of one tooth to the center of the next tooth, is called the circular pitch. In calculating gears it is necessary to know certain fixed proportions which are given herewith in both common and decimal fractions:

Thickness of tooth equals 12-25, or .48, of the circular pitch.

Width of space equals 13-25, or .52, of the circular pitch.

Height of tooth equals 7-10, or .7, of the circular pitch.

Height of tooth above pitch line equals 3-10, or .3, of the circular pitch.

Depth of tooth below pitch line equals 2-5, or .4, of the circular pitch.

In small wheels the width of tooth equals twice the circular pitch.

We will only consider one form of tooth which is called the single curve or involute system, and is adopted on account of ease of setting out and cutting, and general efficiency. Let us now proceed to set out a gear having this form of teeth.

We will select one of forty teeth, ½ inch, circular pitch on account of ease in explaining the method. We first find the diameter of pitch circle by multiplying the pitch by the number of teeth and multiplying their product by .3183. That is, ½ inch times 40 equals 20 inches and 20 inches times .3183 equals 6.366 inches which is approximately 6⅜ inches.

With a pair of compasses describe a circle (X) of this diameter. Using the dividers, point off this circle into parts equalling one-half the pitch which is, in this case, ¼ inch. Next, draw a line (A — a), Fig. 1 from the center to one of the points on the pitch circle. With a radius equal to one-half the length of this line erect a semi-circle (C) with point (B) as a center. Now draw circles representing the depth of teeth (Y) and the height of teeth (Z) according to the table. That is, the circle (Y) will be 2/5 of the circular pitch below the pitch circle (X) and the circle (Z) 3/10 of the circular pitch above. With a radius, equal to one-fourth of the diameter of the semi-circle (C) and the point where pitch circle

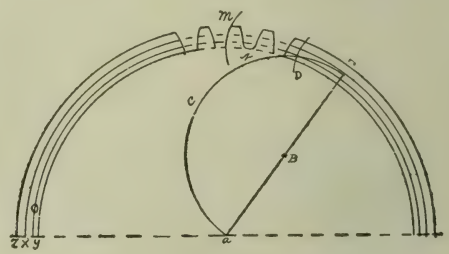


Fig. 1.

(X), radius (A—a) and semi-circle (C) meet, draw an arc (D) through semi-circle (C). With (a) as a center and a radius equal to distance from (a) to point (D) describe circle (O), which is called the base circle. The centers for arcs forming sides of teeth lie on this circle. The diameter of the circle (O) or base circle is .97 of the diameter of the pitch circle. Now, set the compasses again to a radius equal to one-fourth the diameter of the semi-circle (C) and, letting one leg pass through the points made in dividing the pitch circle and the other leg resting on base circle, draw arcs forming sides of teeth as at M. The bottoms of spaces can now be rounded off by hand as at N.

If the fore-going instructions be carefully

followed there should be no trouble in setting out any spur gear on paper.

To cut a gear from the blank the first thing to do is to lay out the gear on paper. Next make a templet of thin brass or zinc, cutting out to the exact form of space between two teeth. This is for shaping the cutting edge of rotary cutter. To make the cutter, mount a round piece of steel previously softened, on a mandrel in the lathe. Turn up the edge to exact form of templet. Remove from mandrel and file teeth in cutting edge, or teeth may be milled in, using the division plate and milling attachment. Heat to a cherry red and plunge in cold water. Heat a flat piece of iron to a white heat and hold the cutter over it until it is

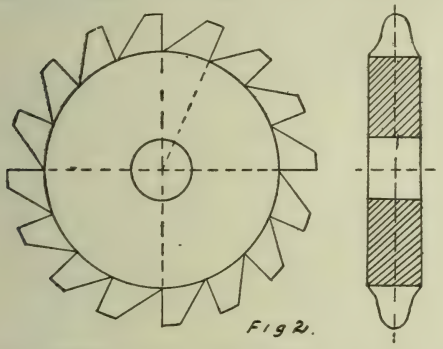


Fig 2.

of a straw color after which cool out in water. The art of tempering is only learned by long practice but once learned is never forgotten. Having finished the cutter, mount it in the milling attachment and mount the gear blank on a mandrel between lathe centers and, using the division plate to space the teeth, mill them out as previously instructed.

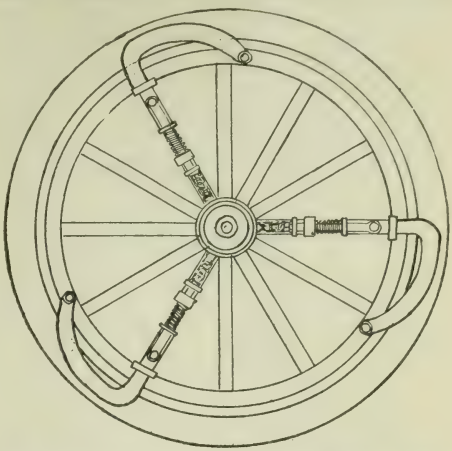
A form of cutter is shown in Fig. 2 and needs no further explanation. Cutters can be made from old flat files by softening them and cutting roughly to form with a hack saw or file and finishing in the lathe.

TROLLEY CAUSES APPENDICITIS.

The trolley car, in that it causes us to walk less than we used to, is the cause of the alarming increase in appendicitis, declares Dr. Thomas W. Lauterbon of New York. He says that when the abdominal and intestinal muscles are kept continually active by walking, the entrance to the appendix is always closed and there is no danger of appendicitis. That there is something in his theory seems true, since appendicitis does not flourish in the country as it does in the city.

SIDE-SLIP PREVENTER FOR AUTOS.

A Dublin, Ireland, inventor has devised an appliance which prevents an automobile from sliding out of its course when swing-



The Nicholson Side-Slip Preventer

ing around a corner at high speed. The Motor News, Dublin, says: "There are three grippers, made of sheet steel, and they work on a stud fitted on to a ring, concentric with the rim of the wheel. When in action the edges of these grippers are level with the tread of the tire, and consequently just touch the ground as the wheel revolves, with the result that side-slip is checked in its inception by the edge of the gripper coming in firm contact with the ground. The gripper is so designed as to roll into action, and it is fixed quite clear of the tire, which is consequently unaffected. In the drawing the gripper is shown out of action. That the contrivance is effective as a non-slipper we can state definitely from personal experience."

The mechanism is worked by means of a hand lever.

METAL RESEMBLES SILVER.

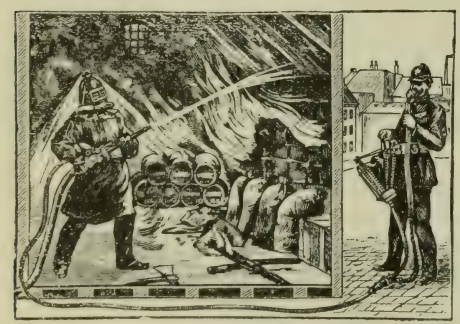
Aluminum silver, or "silver metal" composed of copper 57 parts; nickel, 20 parts; zinc, 20 parts; and aluminum 3 parts, is an alloy coming into use by typewriter companies for the spacing lever. It is nickel-plated when the machine is new, but as the nickeling wears off it still remains of a silver white color which will not tarnish or rust. This metal is conceded to be better than either brass, steel or iron for this purpose. It is stiff and strong, does not cost more than brass and will take on a high polish because of its hardness.

HOW TO WRITE ON PHOTO NEGATIVES.

It is very often desired to inscribe a title upon the negative of a picture so it can be printed at the same time. Copyright inscriptions are especially necessary to be handled in this way. The Photo Beacon gives an easy method as follows: Lay the negative on a piece of white paper, glass side up, and place a drop of retouching fluid where you wish to write the title. Rub it into position with the finger, let it dry for a few moments and then with a medium soft pencil write your title. Since the writing is on the glass side, it does not need to be reversed. You may take a rubber stamp and print in the ordinary way, as the medium will hold the ink. Of course, the whole thing may be rubbed off by using a little turpentine.

SMOKE HELMETS FOR FIREMEN.

Smoke helmets for city firemen are generally used in Germany. A fireman wearing one of these strange looking head gears much resembles a diver, especially as the comparison is carried out to the tube corresponding to the diver's air pipe. The helmets are made of stiff leather, with win-



Fireman's Helmet

dows for the eyes, and a tight fitting collar. The hose pipe enters the back of the helmet and fresh air is pumped constantly by a pair of hand bellows at the other end of the pipe, which also serves as a speaking tube. Conversation is readily carried on for distances up to 160 feet. A fireman thus equipped can work for hours in a smoke which would otherwise cause his death in a few minutes. The helmets have been the means of saving a number of lives and much property, and their success will doubtless induce their early adoption into America.

50-MILES-AN-HOUR BOAT PLANNED.

Shaped and Propelled to Skim Over Water Instead of Cutting Through

Foreign automobile manufacturers are now interesting themselves in fast boat building. A plan has matured, according to the London Times, for the building of a boat propelled through the water so fast and of a shape "so cleverly devised that instead of cutting through the water it will skim over it, thus reducing water friction to an absolute minimum." S. F. Edge, a noted English racing automobilist, is confident in his belief that the boat will attain a speed of 50 miles an hour, "but the astonishing pace of 35 miles an hour," he says, "may be regarded as a certainty."

HOTEL BOATS FOR THE MISSISSIPPI.

Revival of Old Time Magnificence in River Travel

Steamboat travel on the Mississippi is to be restored this year to its old time comfort and splendor. River palaces which for years have been used only as freighters are being overhauled and fitted up in the most luxurious manner. Consorts, without power, will be equipped as floating sleeping hotels, and will be towed by fast gliding boats.

The attractiveness of a river trip which before the war made the water route preferred to the steam cars, is to be eclipsed. The great fair at St. Louis is the cause, and it is expected thousands living far from the banks of the river will enjoy for the first time in their lives the beauty of water and scenery afforded by this great waterway.

The steamers will contain the kitchens and dining rooms, and accommodate a large number of sleepers, while the consorts will have only cabins and staterooms. An orchestra will play every afternoon and in the evening there will be dancing on the main deck. On arrival at St. Louis the boats will be the hotels of their guests, and each night at midnight the boats will steam 15 or 20 miles up or down the river to escape the smoke and noise of the city. With engines working just enough to hold the boat against the current, and with cool breezes wafting through the boat, the guests will enjoy a good night's rest.

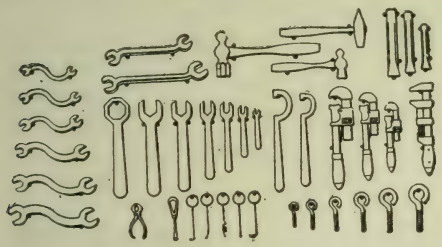
At daybreak the boats will tie up at their wharf near the fair grounds.

Send for Popular Mechanics premium list.

SHOP NOTES

TOOL RACK FOR ENGINE ROOMS.

Engine room tools, such as wrenches, hooks, etc., may be very conveniently arranged on a rack specially fitted for the purpose. Measure the space you can use for the purpose, being sure it is conveniently located. Lay out your tools, on a



Arrangement of Tools on Rack.

board of the proper dimensions, ranging them according to size and reversing the sizes where one row comes under another. Bore holes to fit the wrenches, and put screws for holding the tools in the places you have indicated on the board.

HOW TO WELD A STEAM DRILL.

To weld a steam drill say a 1¼-inch drill, split the steel both ways for about an inch, making four prongs. Turn them nearly straight and scarf the end of each prong to a sharp point. (See Fig. 1). Heat to a

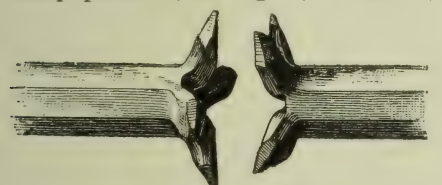


Fig. 1.

Fig. 2.

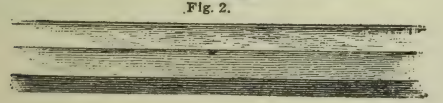


Fig. 3.

bright red, place together and hammer as in Fig. 2. They will hold closely. Place in the fire till in a white heat. By the help of an expert striker it can be welded with one heat as solid as in Fig. 3.

The correspondent, who describes this method in The Blacksmith and Wheelwright, says he has welded over a hundred drills the past year in this manner and never yet had a break.

HOW TO MAKE AN IRON BOOT FOR A CRIPPLE.

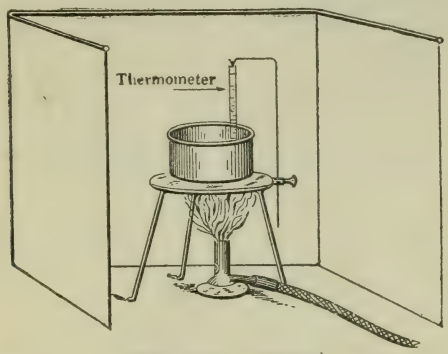
An iron boot for a cripple may be made by fitting a piece of old hand saw blade, the size of the heel and sole of the shoe, for the top, says a correspondent of the American Blacksmith. Take two pieces of tool steel (¼-inch) and bend them to the proper shape and rivet them to the sole piece. Fasten the iron boot to the shoe by means of small screws.

Boot for Cripple.

TO TEST LUBRICATING OILS.

A good test for lubricating oils is the flash test. Make a tripod of heavy wire and place it over an alcohol lamp or a Bunsen burner. Place a shallow enameled-ware drinking cup on the tripod, and from a wire support suspend a thermometer so that the bottom of the bulb will be about ½ or ⅜ inch from the bottom of the cup. The thermometer should register to about 600 or 700 degrees, and should be accurate. "A well-seasoned, gas-filled thermometer is best," says Power, "and will cost about $2.50 or $3.00." Around the instrument place a screen of sheet iron to protect it from drafts. Fill the cup to within one-eighth inch of the top, with the oil to be tested. Light the lamp and adjust the flame so the temperature will rise about 15 degrees per minute, not more. When at about 250 or 300 degrees Fahr., adjust it to about 10 degrees per minute. Have ready some pieces of hard-spun wrapping twine or some

toothpicks. If testing engine oil, light one of these pieces when the temperature approaches 300 degrees Fahr., and pass it across the surface of the oil. Repeat the operation from time to time as the temperature rises, until a faint puff of blue flame ensues. Note the temperature, which is the



Flash Test Apparatus.

flash point. The burning point is the temperature at which the oil ignites of itself and continues to burn.

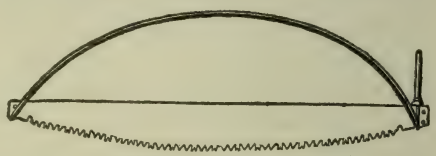
HOW TO MAKE A STEAM BLOWER.

In an emergency steam blowers may be used to provide draft for the combustion of coal in steam boilers. Fig. 2 shows a blower which was constructed for use with a battery of boilers of 125 horsepower to maintain a uniform steam pressure of 80 pounds during the cold winter months. "The blower was placed in the 48-inch circular uptake, the holes drilled so that the hollow jet would fill the uptake at about four feet from the jet," says a correspondent in Power. This increased the capacity 30 per cent, at a cost of 90 cents per hour, with coal at $3.00 per ton.

The jets give better service in round stacks than they do in square ones. Inserting a tube into a square stack, filling up the corners and placing the jet underneath is the most efficient method of using them with square stacks.

HOW TO STIFFEN A CROSS-CUT SAW.

One man can work a cross-cut saw by means of a simple contrivance for stiffening it. Make a strong, stiff bow, saw a slit in each end five or six inches long; take off one saw handle and insert a plug in one of



Stiffening a Cross-Cut Saw.

the holes in the saw. Slip one end of the bow over the saw in front of the plug and tie underneath with wire; bend the bow and slip the other end over the saw in front of the handle and tie as before. Have the teeth filed very beveling so as to bring as thin a cutting edge against the saw as possible, and do not file the rake teeth as short as you would if two men were working it. A correspondent of the Rural New-Yorker says you will be surprised how well it works.

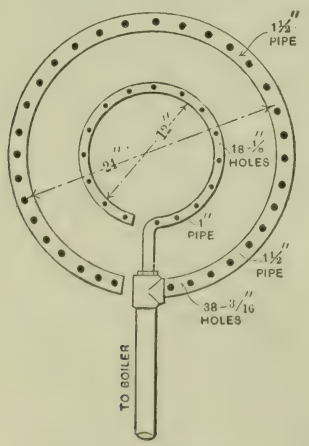


Fig. 2

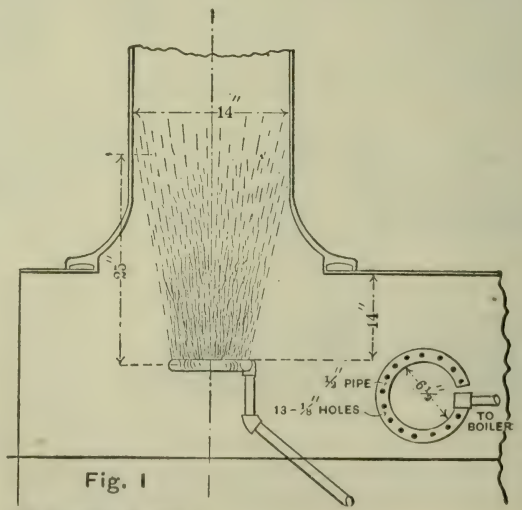


Fig. 1

Use of Steam Blower.

PAINT FOR STEEL PLATES.

One of the large railroad companies uses the following recipe in making an excellent protection for exposed steel plates:

Four pounds pure lamp-black ground in raw linseed oil, seven-eighths gallon genuine asphaltic varnish, one-quarter gallon pure refined linseed oil, one-quarter gallon drying japan. One gallon of the paint will cover 350 square feet of surface.

HOW TO UNITE CAST IRON.

To unite ordinary cast iron is not an easy task, but it may be done, if one has luck, by boring a dozen holes in the parts to be united, then secure well and place about the break an abundance of filings of good pig iron, some wrought iron filings and also some of steel. Lute with fine clay and place in fire (before luting use any good flux, borax, etc.); heat until the filings melt and fill all the cavities. Let remain in the fire until fire goes out and the metal is cold; then remove and clean up.

TINNING CAST IRON.

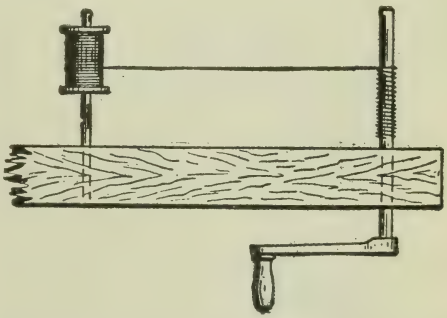
To be successful in coating with tin the castings must be absolutely clean and free from sand and oxide. They are usually freed from imbedded sand in a rattler or tumbling box, which also tends to close the surface grain and give the article a smooth metallic face. The articles are then placed in a hot pickle of one part of hydrocloric acid to four parts of water, in which they are allowed to remain from one to two hours, or until the recesses are free from scale and sand. Spots may be removed by a scraper or wire brush. The castings are then washed in hot water and kept in clean hot water until ready to dip. For a flux, dip in a mixture composed of four parts of a saturated solution of sal ammoniac in water and one part of hydrochloric acid, hot. Then dry the castings and dip them in the tin pot. The tin should be hot enough to quickly bring the castings to its own temperature when perfectly fluid, but not hot enough to quickly oxidize the surface of the tin. A sprinkling of pulverized sal ammoniac may be made on the surface of the tin, or a little tallow or palm oil may be used to clear the surface and make the tinned work come out clear. Some operators again dip in a pot of hot palm oil or tallow at a temperature above that of the melted tin, for the purpose of draining the excess of tin and imparting a smooth, bright surface to the castings. As soon as the tin on the castings has chilled or set, they should be washed in hot sal soda water and dried in sawdust.

TO DRILL CHILLED CAST IRON.

To drill chilled cast iron first draw the chill. This is done by laying the piece on the forge, covering the spot to be chilled with sulphur, and working the bellows slowly until the sulphur is burned off. Then proceed with the drilling.

HOW TO HARDEN BRASS AND MAKE SPRINGS.

Brass can be hardened by hammering or running through rollers while cold, says the American Blacksmith. To make a coiled spring, say a 5/16 spring, take a ¼-inch iron rod, put a crank on it or bend to shape of



crank and let it run out at one end. Bore a hub in a block of wood so the iron will fit tight, and run it through, fasten your wire on it and wind it on by turning the crank, having your spool post so you can hold it tight enough to stretch the wire.

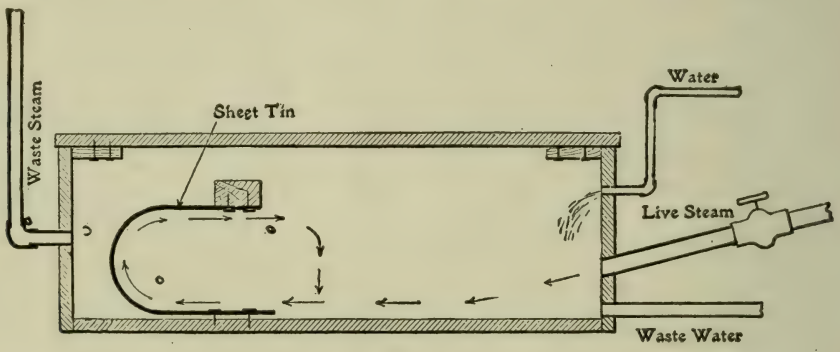
TO CLEAN CHASED BRASS.

Benares ware, or chased brass of any kind, may be cleaned thus: Wash well with hot water and soap and dry thoroughly; then rub all over with a lemon cut in half. When it looks quite clean, rinse well in warm water, dry and polish with a chamois leather. Chased work of any kind should not be cleaned with powder.

DEVICE FOR WASHING OVERALLS.

In the boiler house of the Union Steel Co., at Honora, Pa., the men have constructed a device for washing overalls, which will take the dirt and grease out of the worst possible specimen, and do it quickly. The sketch shows the machine.

The overalls are put in and the lid is closed, a fine stream of cold water is turned on, the live steam is started and they are then left to wash themselves. There must not be over an inch of water in the bottom.



FOR WASHING OVERALLS.

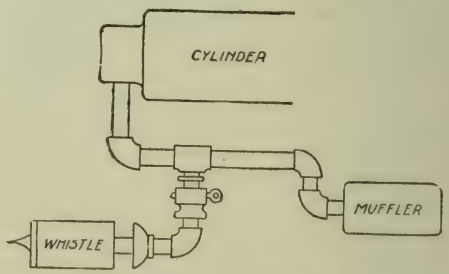
The live steam strikes the cloth and carries it in the direction of the arrows to the sheet tin. The cloth is compelled to follow the curve of the tin up and around. Then it drops in the stream of steam and water again, and so on. As it works in practice the cloth is passing around the tin continuously, being kneaded and turned in the hot water until it is perfectly clean. No soap was used, yet no doubt it would have shortened the time. An ordinarily dirty pair of overalls would be cleaned in two or three minutes. The box is about 4 feet long, 3 feet wide and 2 feet deep, but could perhaps be made smaller without harm. If too much water is used in the bottom, the steam tears the cloth instead of moving it.

WHISTLE FOR GAS ENGINE.

The most strenuous thing yet in the way of an alarm horn for automobiles has been discovered by S. W. Rushmore, of Jersey City. Beside it the shriek of the fire boat is like a child's whistle and the fog horn would be inaudible if they were blown simultaneously. Mr. Rushmore thus tells the Automobile Magazine how he came by the invention:

"I blew up the muffler of my Winton machine and noticed that a considerable increase of power accompanied the exhaust, and decided to see what gain there would be in cutting out the muffler of my 12-horsepower Packard. I placed a T in the exhaust pipe and to this connected a 1½-inch brass blow-off valve with lever connected to a foot button. I also coupled on an elbow so that the blast is directed backward and does not stir up a dust. Just as I got the thing finished I noticed in the shop a tug-boat whistle with a bell 5 inches diameter and 12 inches long, that exactly fitted on the pipe. I screwed it on, as per sketch herewith.

"When the relief valve was opened the whistle let out the most unearthly shrieks, showing that as the whistle was set for 100 pounds steam the initial pressure of the exhaust in the pipe leading to the muffler exceeded that amount. Each shriek was apparently of shorter duration than the length of a stroke and I thus argue that the excessive initial back pressure is not due to any defect in the muffler but to the inertia of the gas in the pipe leading to it.

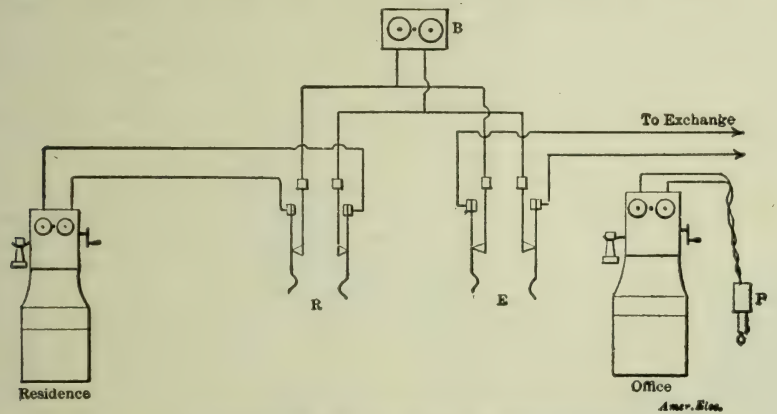


Connection of Whistle

"The thing is a great success in waking up truck farmers that I meet on the road, before they know what they are up against."

CONNECTING AN EXTRA TELEPHONE.

An arrangement whereby a telephone subscriber can connect his private office or residence on his office telephone, while subscribing for only a single instrument is given herewith: The office telephone set is connected to an ordinary two-wire plug, P, and two spring jacks, R and E, are provided, into either of which this plug may be inserted. With the plug inserted in the jack R, the residence instrument and the office instrument are connected together, leaving only the bridging bell, B, connected to the exchange circuit. With the plug inserted in the jack E, the office instrument is connected to the exchange wires, and the residence line terminates at the bridging bell, B. With the plug removed, as shown in the diagram, the residence instrument is connected straight through to the exchange.



CONNECTIONS FOR OFFICE AND RESIDENCE LINE.

The provision of the bridging bell, B, enables the exchange to call up the office when the office instrument is connected to the residence line, and also enables the residence to call up the office when the office instrument is connected to the exchange line. The plug would be withdrawn from the jacks, leaving the residence connected through to the exchange, only over night and during periods when the office is closed.

PREDICT WEATHER WITH CAMPHOR.

A piece of camphor gum is a very good indicator of what the weather is going to be. If, when the camphor is exposed to the air, the gum remains dry, the weather will be dry; if the gum absorbs moisture and is damp it is an indication of rain.

HOW TO MAKE A SPARKING COIL.

For a sparking or induction coil strong enough to ignite paper or cloth make a magnet core of a bundle of soft No. 20 iron wire, ¾ inch in diameter and 6 inches in length, wrapped in two thicknesses of strong paper laid with shellac varnish for insulation. Put thin wooden spool heads on the ends of the core wrappings, fastened with shellac varnish, says the Metal Worker.

Then wind the spool with four layers of No. 16 cotton-covered copper wire, with shellac varnish on each layer, passing the wire ends through holes in the spool head at the level of the last layer. Cover the coil with four thicknesses of wrapping paper well shellacked for insulation from the secondary current.

For the secondary coil, wind with 12 ounces of No. 34 double silk-covered copper wire, commencing by passing the wire through a hole in the spool head close to the paper winding of the primary coil. Cover each winding of the secondary coil with two thicknesses of wrapping paper, well shellacked to make the insulation perfect against short circuiting of the secondary current. Special care in closing each paper winding against the spool heads is very essential to prevent burning out. Dry the shellac varnish as the work proceeds.

With 10 medium sized dry batteries in series, a 1¼-inch spark may be obtained between wire terminals or a ½-inch hot spark between brass balls of ¾ inch in diameter. With eight Edison-Leclanche cells and a vibrating attachment, a brilliant spark effect may be had between the brass balls.

HINTS ON MELTING BRASS.

The following points were made by Chas. Vickers, of Chicago, in an address before the Boston meeting of the American Foundrymen's Association:

Compared with steel or iron it is an easy matter to melt brass. It is often melted on a small scale in an ordinary stove. Great waste of fuel occurs in using a 30-inch pot in a furnace intended for an 100-inch. Three inches of solid fuel should surround the pot, and will do the work of six or more. Tossing metal into the pot causes great waste by splashing. Be sure the molds are ready by the time the metal is ready to pour—costs money to "hold" a pot in furnace. Never allow your furnace to become barrel-shaped; straight sides are best. Gas in the shop is often caused by the furnace flues being too small; rather than the main flue. A fan in the main flue is good. When sheet iron is used for main flue it must be suspended and not allowed to touch the wall. Do not cover flues with asbestos to protect workmen from the heat; hang a curtain of asbestos, but do not let it touch the flue.

TO PICKLE BRASS CASTINGS.

The following method of pickling brass castings is recommended: If greasy, the castings should be cleaned by boiling in lye or potash. The first pickle is composed of nitric acid, one quart; water, six to eight quarts. After pickling in this mixture the castings should be washed in clear warm or hot water, and the following pickle be then used: Sulphuric acid, one quart; nitric acid, two quarts; muriatic acid, a few drops. The first pickle will remove the discolorations due to iron, if present. The muriatic acid of the second pickle will darken the color of the castings to an extent depending on the amount used.

HOW TO AVOID "SWEATY" PIPES.

The cause of so-called sweaty pipes is very simple and the remedy equally simple. Perhaps it is hardly necessary to explain that the pipes are not sweaty in the sense that the moisture comes through the pores from the inside, though this is a not uncommon belief among those who do not understand the cause. The moisture on the pipe is, of course, caused by the condensation of the moisture in the air, the difference in temperature between the air and the pipe causing the condensation of the natural moisture in the air and depositing it on the pipes. The difference in temperature between the air and the pipe is caused by the water flowing through the pipes. Water at rest in the pipes soon takes nearly the same temperature as the room. Even an occasional flow of water through the pipes will not cool them sufficiently to make them sweat, but even a slight constant dropping will cause the trouble. That being the case, it is only necessary to make tight all faucets and cocks on supply and flush pipes in order to put a stop to the trouble. Packing the pipes will of course help matters, but this is expensive and unnecessary.

CONNECTING PIPES WITH RIGHT AND LEFT COUPLING.

"While speaking of piping I thought of something today that I might have thought of years ago with profit," says a correspondent of The Engineer. "In connecting two pipes with a right and left coupling try the coupling on each pipe, and count the number of turns necessary to screw it on each one by hand. You generally find that the left-hand one will require two turns more than the right-hand. This is because the left-hand dies are not used as much as the right-hand, and consequently they cut a smaller thread.

"In order to have both ends of the coupling make up the same, the end of the coupling that screws on the pipe farthest should be started first and given as many turns as is necessary to equal the difference between the number of threads employed at each end. This should be done before starting it on the end of the other pipe. For instance, if the coupling covers 12 of the left-hand threads and only nine of the right-hand threads at the opposite end, then the end having the left-hand threads should be started first and be given three turns before starting the end having the right-hand threads. This will enable the coupling to be screwed up tight on both pipes at the same time."

CEMENT FOR PIPE JOINTS.

At a meeting of the Ohio Gas Light Association in Columbus, Mr. George Light recommended a cement for pipe joints, consisting of a mixture of ordinary pine tar and dry oxide of iron. This cement, Mr. Light stated, is as good in a faced or rough

flange joint as red-lead putty, costs about one-tenth as much, does not harden as quickly as red lead, and is very adhesive under pressure.

HOW TO USE CEMENT IN COLD WEATHER.

In cold climates the employment of concrete has its objections, in that the material will freeze before it sets, and upon thawing is found to be practically worthless. In such cases the operation of setting may be hastened by dissolving two pounds of carbonate (not bicarbonate or cooking) soda in one gallon of water, boil the solution and use it in mixing the concrete with whatever additional water is required; the water and sand should also be heated. This heat will remain long enough to allow the concrete to set, which should be about 45 minutes. Subsequent freezing, if the mass is not thereby cracked, will not injure the concrete.

SWITCHBOARD POLISH.

For polishing white marble switchboards the following dressing may be applied with white flannel: Ten parts white wax, two parts Japan gold size, and 88 parts turpentine.

HOW TO MAKE METAL POLISHES.

It is not difficult for any person to make his own metal polish. It can be done cheaply and will probably give him better satisfaction than the polish he buys. Here are a few recipes for good polishing soaps:

1. Twenty to 25 pounds liquid curd soap, intimately mixed with about 30 pounds of fine chalk and one-half pound Venetian red.

2. Twenty-six pounds liquid cocoanut oil soap, mixed with 12 pounds tripoli and one pound each of alum, tartaric acid and white lead.

3. Twenty-five pounds melted cocoanut oil saponified with 12 pounds soda lye of 38 to 40 degrees B., after which three pounds rouge, three pounds water and two ounces ammonia are crutched in.

Polishing soaps are generally cut into cakes and stamped or pressed and brought into commerce with directions for use. The directions generally state that a small quantity of the soap is put on the metallic article to be polished with a damp flannel and rubbed until the desired polish is obtained.

PASTE FOR MOUNTING PURPOSES.

To prepare a paste for mounting purposes.—Mix three-quarter ounces of starch with a little water to form a smooth cream, and pour on it sufficient boiling water to make 10 fluid ounces. Take one-half ounce of glue, allow it to soak in cold water till quite soft, pour off the excess of water, melt the glue down by gentle heat, and stir into the paste previously made. Now add one drachm of alum and a few drops of oil of cloves and stir well until dissolved. If the material should dry too hard, add one or two drachms of glycerine.

COLORLESS VARNISH.

Colorless varnish for use on fine labels or other prints, as well as for white wood and other spotless articles, is made as follows: Dissolve two and one-half ounces of bleached shellac in one pint of rectified alcohol; to this add five ounces of animal boneblack, which should first be heated, and then boil the mixture for about five minutes, filter a small quantity of this through filtering paper, and if not fully colorless, add more boneblack and boil again. When this has been done, run the mixture through silk and through filtering paper. When cool, it is ready for use. It should be applied with care and uniformity.

COST AND HANDLING OF GLUE.

More than $7,000,000 annually is spent in the United States for glue and yet few people know how to buy or use it. Made up properly the better grade requires 39 pounds of glue plus 61 pounds of water to give 100 pounds of liquid glue ready in the pot for joining hard wood, says the Wood-Worker. From the cheap glue we must take 42 pounds of glue plus 58 pounds of water to get our 100 pounds of glue liquid. The better glue requires 10 per cent less glue, but 10 per cent more water in order to get the same quantity of liquid from both, namely, 100 pounds of exactly the same fluidity of body.

The difference between the two glues in regard to strength is fully as large as the

difference in spread. The better grade carries a strain of at least 47 pounds, while the other only resists 39 pounds.

To get the cost, multiply the required number of pounds of dry glue with the price, and we have the cost of 100 pounds of liquid. For the joint glue we need 39 pounds of glue (and 61 pounds of water) costing 12 cents per pound dry glue, or $4.68 for 100 pounds liquid glue. For the lower grade we must take 44 pounds glue (and 56 pounds of water) at 9 cents per pound dry glue, at a cost of $3.96 for the 100 pounds in the pot.

Both glues give the same quantity, namely, 100 pounds of liquid of exactly the same body, and the 100 pounds glue liquid from either will, of course, cover exactly the same surface. To use the better grade costs $4.68; to use the lower grade, $3.96, or 72 cents less. The cost is in favor of the lower glue if the strength of the work done is to be ignored, but for the general use of the wood-worker the better grade will, in the long run, be found the cheaper.

UNCLE SAM'S WHITEWASH RECIPE.

A whitewash used on government buildings is made as follows: Take a half bushel of unslacked lime, slack it with boiling water, cover during the process to keep in steam, strain the liquor through a fine sieve or strainer. Add to it a peck of salt previously dissolved in warm water, three pints of ground rice boiled to a thin paste stirred in while hot, half a pound of Spanish whiting and one pound of glue previously dissolved by first soaking in cold water and then by cooking in a small pot hung in a larger one filled with water. Add five gallons of hot water to the mixture, stir well and let stand a few days covered as nearly airtight as possible. It should be applied hot, for which purpose it can be kept in a portable furnace.

TALLOW FOR CUTTING TOOLS.

Tallow is better than the best lard oil in cutting threads in iron. A reader of the American Machinist tells how he accidentally found this out. He was cutting 1-inch taps and found it impossible to use the oil furnished him. Seeing an old piece of candle on the shelf he tried it with success. It is cleaner, does not run, and on small work the heat from the friction of the cutting tool and the center is sufficient to melt it as the tool goes along. In cutting inside threads it stays where needed and is considered a great improvement over oil.

For cutting threads on copper use beeswax.

TO MAKE CELLULOID NON-INFLAMMABLE.

A process of rendering celluloid non-inflammable has been patented. To 25 parts of celluloidine, dissolved in a sufficient quantity of solvent, are added six parts of chloride of magnesium dissolved in either alcohol or methylated spirit and three parts of pulverized pure asbestos. These constituents are worked into a paste and may be applied either during or after the process of manufacture.

ANTIDOTE FOR AMMONIA FUMES.

Employes in ice and refrigerating plants are sometimes overcome by the fumes of the ammonia used in the process. In such cases a good stiff drink of vinegar will help to counteract the action of the ammonia, revive the unconscious, and in many cases save life. If the victim is unconscious, it may be necessary to pry his jaws open to get the vinegar down.

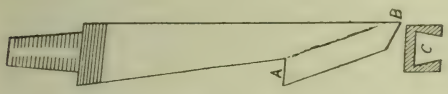
VALUABLE METHOD OF PRESERVING BLUE PRINTS.

The superintendent of a large car shop thus describes his method of preserving blue prints. His first method was to fasten the prints on ordinary flat sheets of pasteboard. These answered fairly well for a time and kept the prints flat, but the pasteboard became broken and oil-spotted. He then hit upon the idea of using thin sheet iron as a backing, and this proved eminently satisfactory. All the prints in common use in the shop were first pasted on these pieces of sheet iron, then both sides were varnished over, so as to make the paper oil and waterproof. After being subjected to this treatment, these prints can be hung up near the machines. They are always flat, clean and clear, and they can be filed away in small shape when not in use. Moreover, they are practically indestructible, because when soiled they can be put under the hose and washed off. The plan has been in use for about six years, and has proved very satisfactory.

CORE-DRAWING MORTISING CHISEL.

A writer in the Wood Worker thus describes a handy tool which any mechanic can easily make.

Take an ordinary chisel and file the bottom of groove a trifle wider than top, as in-



dicated at C in sketch, and a trifle wider at A than B, he will have no more trouble with tight cores. A long bevel on inside edges, as indicated by dotted lines, also blunt bevel on lips, will greatly improve the drawing qualities of the chisel.

ATTACHING A LIGHT WATER-JACKET TO GASOLINE ENGINE.

In a paper read before the Institution of Mechanical Engineers, London, Capt. C. C. Longridge described a novel, but simple method of attaching a water-jacket to the cylinder of a gasoline engine. Reference to

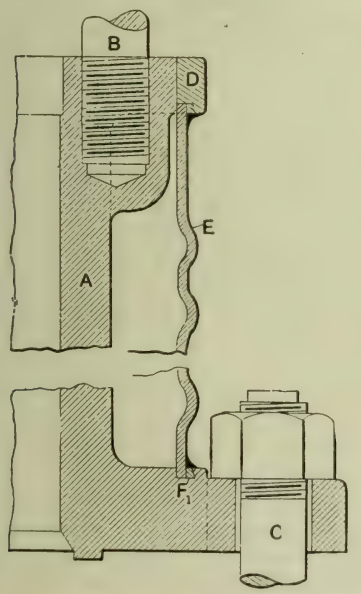


Fig. 1.—Showing How Water Jacket is Attached

the cut, Fig. 1, will make plain the following explanation: A the cylinder; B C studs securing cylinder head and frame; D iron or steel ring forced over the cylinder head and grooved to receive the jacket; E steel metal jacket; F F copper wire calked into groove; black surfaces represent solder if added.

He also describes a new combined inlet and exhaust valve for gasoline engines. Referring to Fig. 2: The exhaust valve E is recessed to receive the inlet valve D. F the cap of the exhaust valve spindle, is actuated by a two-to-one shaft and rod, not shown.

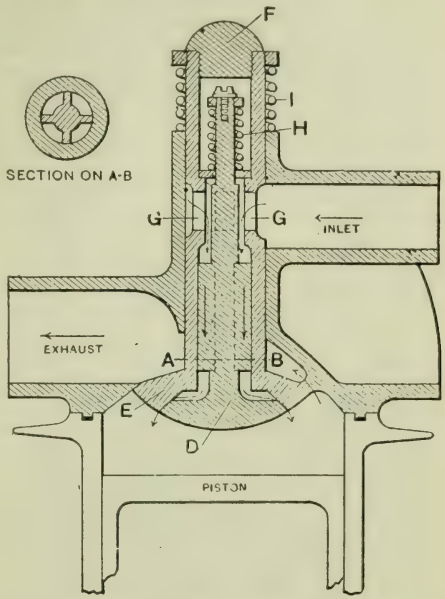


Fig. 2.—D'equevilly Combined Inlet and Exhaust Valve

I is the exhaust valve spring; H a weaker spring for the inlet. The shock of the exhaust spring closing, bounces the inlet valve at the same moment. The inlet valve stem is fluted, as shown in section across A B, forming channels for the charge to the head of the valve.

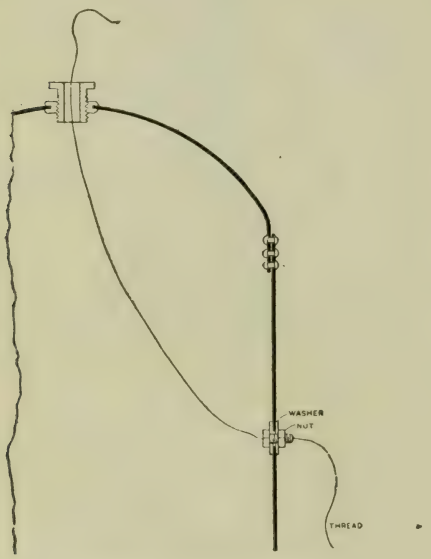
TO KEEP INK BOTTLE IN DRAWER.

To keep the ink bottle, which is only used occasionally, always handy and at the same time out of your way, says the Draftsman, fasten a piece of pine about 1 inch thick and 2½ inches square, with a hole in the center the size of the bottle, in a corner of the instrument drawer; there is no danger of tipping the bottle over here and it is always ready for use.

The turning on of a closed electric light has been found sufficient to ignite vapor ether when in a small room.

REPAIRING A RANGE BOILER.

An ingenious method of stopping a leak in a range boiler, which was too large to solder, is described in the Metal Worker. The plumber made a perfectly round hole at the point of leakage, and large enough to take a ¼-inch bolt with a soft washer in the inside. The bolt and washer were secured together and dropped into the boiler through the hot water opening at the top,



Drawing in the Bolt

a piece of thread being tied to each end of the bolt. The lower end of thread was then fished out through the hole, with a wire; the bolt drawn through and another soft copper washer put in the outside. Cement was freely used and the washers set up tight by tightening the nut. The same scheme can be worked in mending pipes and tanks where the material is too thin to tap and plug.

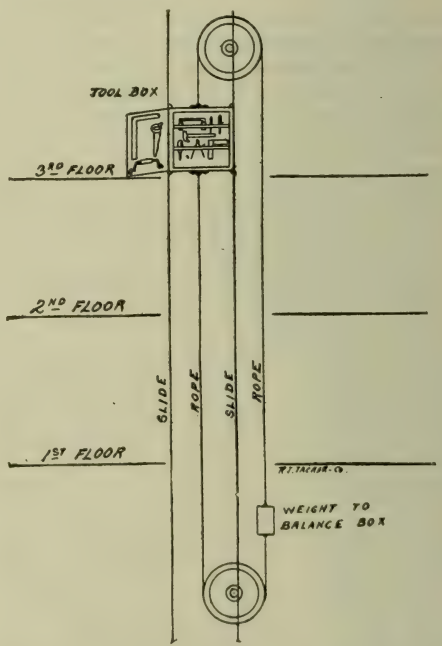
ATTACHMENT FOR LONG FILES.

The file attachment illustrated herewith is something which I find very useful, especially for heavy work, such as plow filing, says a writer in the American Blacksmith.

As is clearly shown, the device consists simply of a ¼-inch rod, one end of which is bent to hook over the end of the file, while the other end passes through a hole in the handle and is threaded to receive a nut. By placing a block under the rod and tightening up on the nut, the file may be given a slight bow downward. This opens the teeth and makes the file cut better. In my opinion, also, it will last longer.

A TOOL BOX ELEVATOR.

The accompanying drawing shows an arrangement that will enable the miller to have his tools on any floor he desires by simply pulling a rope, says the American Miller. The device consists of two sheaves on which a rope is placed. A tool box is



fastened to the rope, to run between two guide posts. On the opposite side of the rope a weight is placed to balance the tool box.

To Strengthen Long Files

Philadelphia's High Pressure Water System

A huge trunk 20 inches in diameter, reaching its octopus-like 8, 12 and 16-inch arms in every direction; a great pumping station, supplied from the Delaware river by means of a 36-inch suction main and having 10 pumps capable of delivering 1,200 gallons of water per minute at 40 revolutions against a pressure of 300 pounds per square inch; above all, each of the large pumps driven by a 280-horsepower gas engine having connection with the city gas mains for fuel and ready to start up at full power any moment without delay or loss. This, briefly told, is the high pressure water system which is to protect Philadelphia's business center, independent of fire engines and of the mains for domestic supply; a system which will carry a great volume of water to the highest floors of tall office buildings and will minimize loss of property and life and reduce insurance rates, in the district protected, 25 cents per $100. The expense may be easily figured in dollars and cents, but it must be placed against inestimable gain.

The building occupied by the pumping plant is 72 by 140 feet, and, besides the ten 11½ by 12-inch vertical, direct-acting Deane triplex pumps already mentioned, has two 6½ by 12-inch pumps of the same type, having a capacity of 350 gallons each and driven by 125-horsepower gas engines. The smaller engines are direct-connected to the smaller pumps through friction clutches and drive electric ignition generators of 7.5 k. w. each and the air compressors supplying air at 200 pounds pressure for starting the main engines. The heavy pumps are brass-fitted throughout, in order to be started up after long periods of idleness, and may be worked singly or together. Their construction is perfectly adapted to their use and they discharge into the common 20-inch pipe.

Where an ordinary water main would not be able to stand the high pressure, and would leak at the joints and waste pressure, these thick, close-jointed mains meet all the requirements. Altogether there are nine miles of pipe weighing 6,500,000 pounds. The pressure in the fire mains is controlled automatically by an electric motor acting on a valve. It may be held steadily at any point under 300 pounds, while a spring relief valve prevents it from rising above that amount.

The Philadelphia equipment is most complete and it is estimated that it will do the work of 40 fire engines with great economy. It is the first city to use gas engines in its pumping station, other cities having obtained their pressure from fire boats or reservoirs.

With four pumps working at 300 pounds pressure, over 40 mighty streams of water

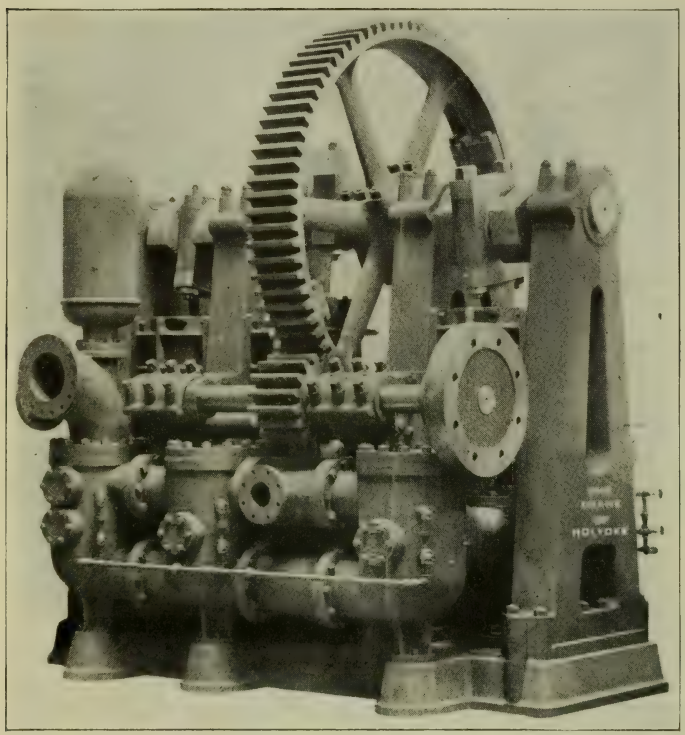
Eighteen High Pressure Streams Thrown in Test of Philadelphia's High Pressure Water System

were forced to a great height in the test of the Philadelphia high pressure fire water system which took place Tuesday, April 19. On the day before the engines of the system had been given a severe test for the benefit of a committee of insurance underwriters. The first engine was started up in a moment by the smallest number of men (3) ever likely to be in charge. Afterwards the entire system was started. The test was for an engine, designated by the committee, to work continuously for 12 hours. With hardly a break the mighty engines and pumps demonstrated their power.

The tests on Tuesday were of a more spectacular nature. Eighteen streams through 2½-inch hose, eighteen 1½ and 1¼-inch streams, supplied by three hydrants, three lines connected to the 3½-inch hose attached to a high pressure hydrant and single streams through 3½-inch hose

comprised the magnificent display. A single stream, handled by one man was thrown to an enormous height, almost to the top of a 21-story building near. Water tower streams were thrown with results greater than the capacity of several fire engines.

The plan submitted by Engineer Geo. W. Jackson to the Commission on High Pressure Water Systems for the City of Chicago



High Pressure Pump for Philadelphia Fire Service

is similar to the Philadelphia system in many respects. However, Chicago's network of sewers and water mains, her tunnels and her prospective subway make the laying of a new system of mains a difficult matter. The proposed plan involves some interesting features and is on a gigantic scale. The plan is for a main conduit or tunnel 8 feet 4 inches by 6 feet 4 inches and 9,000 feet long placed at the center of the Chicago river about 50 feet below the river bed. From this main conduit 4-foot laterals to extend on designated streets to within 100 feet of the dock line; and 4-foot vertical shafts from the laterals to within eight feet of the street line. The large conduit carries a 36-inch pipe and if future conditions require it a second pipe can be placed above the first. The horizontal laterals and the vertical shafts are supplied with 12-inch pipe and to each is connected two 8-inch cast-iron conductors able to bear a hydrostatic pressure of 800 pounds per square inch. The conductors have the necessary valves and fire hydrants. The plan calls for nearly 3½ miles of conduits and about 58½ miles of pipe, the 36, 24 and 12-inch pipe to be of lap welded steel having welded steel flanges, the high pressure test for the largest size being 1,800 pounds per square inch. It is recommended that 4-inch mains be run from the high pressure main to tall buildings and that a sprinkler system worked by compressed air be connected thereto. The 7-foot water tunnel supplying the Harrison street pumping station would be able to supply the new system, also. The tunnel has a capacity of 72,000,000 gallons per 24 hours; the station a pumping capacity of 33,000,000 gallons per 24 hours and the high pressure system is designed for 43,000,000 gallons per 24 hours. A water supply from the river would be undesirable because of the sediment it contains. A telephone line in connection with the mains and for the use of the Fire Chief is another improvement suggested.

It is estimated that a system having 10 fireboats for the protection of the business district would cost $791,940. For the district included from 12th street to Chicago avenue and from Halsted street to Michigan avenue, a high pressure system fully equipped would cost $3,203,480 and by using the fireboat "Illinois" for the present, construction could be begun with the funds now on hand.

Gas engines, because of their great economy, it not being necessary to keep up pressure at all times where they are used, are meeting with high favor and, beyond doubt, the future high pressure water systems of our great cities will use them exclusively.

Send for the Popular Mechanics' premium list.

How a Lake Steamer was Lengthened 72 Feet

Two Great Lakes vessels will have undergone the operation of being cut in two, pulled apart and lengthened in the middle by the opening of navigation this season. The City of Buffalo, a passenger boat, recently was lengthened 42 feet in this manner at Detroit and the same operation has just been begun at Lorain upon the steamer Republic of the Republic Iron Co., at a cost of $75,000. She is to be lengthened 72 feet which will make her 364 feet when completed and which will increase her carrying capacity by one-half and will admit of more hatches and better equipment for ore handling machinery.

The lengthening of the City of Buffalo 42 feet in the middle is also regarded as a notable achievement in Great Lakes shipbuilding. The City of Buffalo is a passenger and package freight steamer built of steel. She was a ship of 2,398 tons burden. The work of lengthening this vessel cost about $170,000.

After being cut in two the forward part of the boat, weighing 1,000 tons, was moved by the engine of the dry dock plant and two powerful horsepower capstans. Just 40 minutes were required to make the pull of 42 feet and when stopped it was almost perfectly plumb with the part of the vessel which had not been moved. By this change in the length of the vessel the freight capacity is increased 50 per cent. The speed of the boat will not be affected in

Bow of the Steamer City of Buffalo, Before Being Moved, also the Blocks, Tackle and Ways.

The Steamer City of Buffalo, After She Had Been Cut in Two and Pulled Apart, Preparatory to Being Lengthened

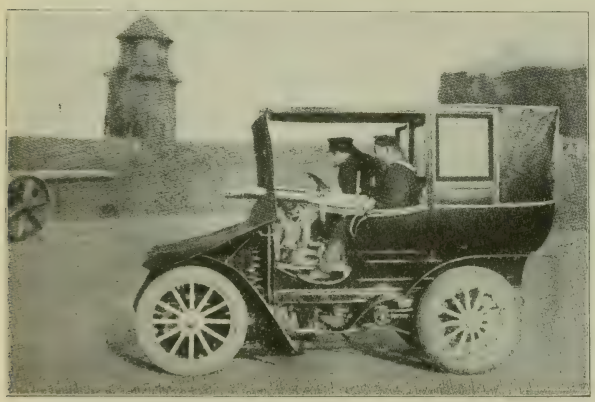
the least, and she will not in the least be weakened by the operation through which she has just passed.

The cut was made just forward of the engines. The beam below the waterline is increased by three feet. Both forward and aft of the new section considerable of the plating had to be removed and some of the frames changed. The lengthening of the City of Buffalo was done under the direction of Mr. Frank E. Kirby, who originally designed this boat.

War Automobile in England

Patterned After American Machine it Becomes Part of the British Army Equipment

Great phalanxes of war automobiles arrayed against each other, with rapid-fire guns belching forth fire and lead and clouds of smoke from either side, may be the battle scene the war correspondent of the future will be called on to describe. Already the automobile has proved a success, but as other nations usually wait for Americans to establish new innovations in battle, as they did the torpedo, the submarine mine, the submarine boat, the monitor battleship, etc., maybe they are waiting for Americans to first demonstrate the utility of this new



Armored Motor Mounted with Maxim Gun

fighting automobile. Well, in reality, the Americans have demonstrated it, but not in an American war, and perhaps that is what is yet required. Americans took a war automobile into South Africa during the Transvaal war and it proved of such help to the British that they have since made the automobile a part of their military equipment. At the gunnery establishment at Whale Island the war automobile—the British call it an "Armoured Motor"—can be seen in almost daily practice and its expeditious and reliable work has won for it great prominence. Recently an exhibition of its performance was given before the king, who was greatly impressed. The British "Armoured Motor" is equipped with Maxim guns. During the king's visit the gun was fired rapidly at targets while speeding at 20 miles an hour with an accuracy that amazed all the visitors.

TWIN CITIES TO HAVE DOUBLE-DECKER CARS.

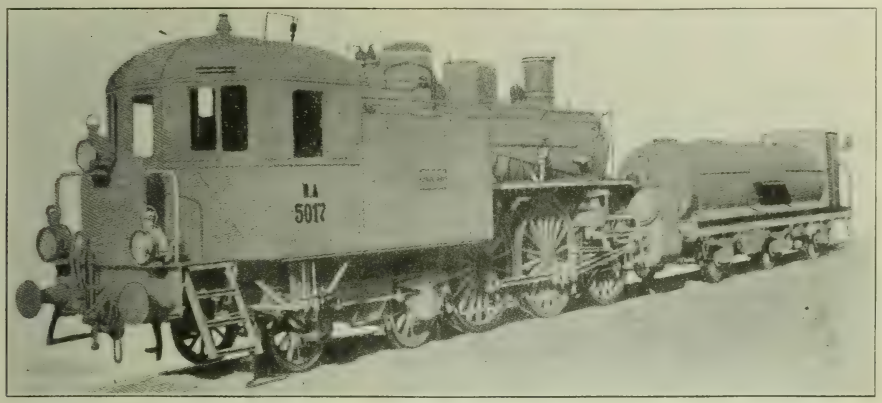
Double-decked street cars are to be placed in service in St. Paul and Minneapolis to aid the inhabitants of those northern twin cities to better enjoy their short but delightful summers. The lower deck is arranged similar to an ordinary street car, except that the top is flat to provide for the seats arranged crosswise on the top deck. The entire seating capacity of the double decker is 52. Passengers enter the upper deck by means of a neat iron stairway at the forward end. The stairs are not spiral as in the case of most other double deckers. The cars were built in the shops of the Twin City Rapid Transit Company, by which they are to be operated. They are of very substantial construction and each is capable of developing 250 horsepower each.

A carving knife 30 feet long and as sharp as a razor is to be exhibited at the St. Louis world's fair. It cost several thousand dollars and is of American manufacture. The blade is of the finest steel and the handle is beautifully carved and polished.

At the greatest ocean depth ever discovered, sounded during a cruise of the Albatross in the Pacific, the temperature was only 35 degrees. The sounding was done near the island of Guam. Prof. Agassiz was in charge of the expedition.

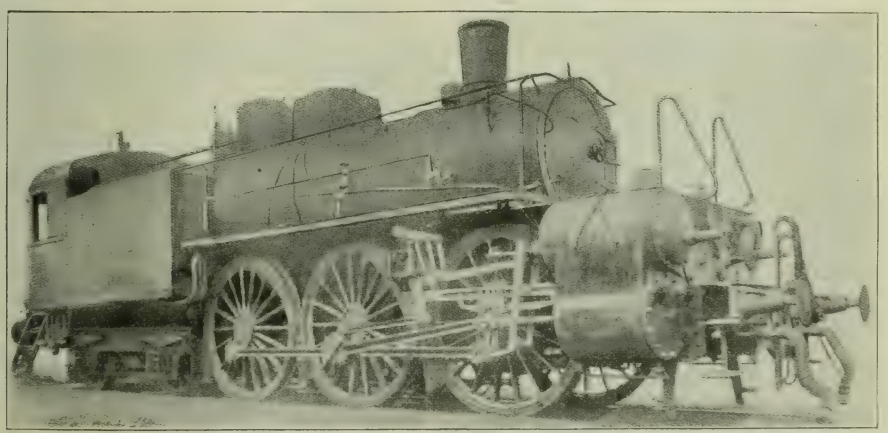
Italian Locomotive Has Enginemen's Cab in Front

The powerful new four cylinder compound locomotives in use on the Adriatic Railway, Italy, have the enginemen's cab in front of the boiler, the chimney coming behind and next to the water tender. This arrangement, says the Railway Review, enables the use of a furnace of exceptional width without raising the boiler to a height impracticable on the railways, for the firebox drops into the free space above the low wheels of the usual front truck. Arranged in this manner a value of nine pounds of steam for each pound of coal, an increase of two pounds over that of the former arrangement, results. In fact, the entire mechanism conduces to economy of power; but two distributors are used for the four cylinders and Smith's system of segmental valve rings is employed.



Front View Italian Locomotive.

The position of the cab gives the enginemen a fine range of lookout and considerably lessens the dangers of railroading. This 4-cylinder compound locomotive is superior to any other now in use. In daily service it hauls five times its own weight at a minimum expense, on one trip with a load of 413 tons using but 45 pounds of fuel per real train mile, with a maximum speed of 65¾ miles per hour. Its power of acceleration is remarkable.



Rear View Italian Locomotive

The next issue of Popular Mechanics will contain an article on how a warship is first built on paper before a single bolt is driven. You will be surprised to learn of the great number of drawings required for a battleship's construction and of the minuteness and accuracy of the specifications.

Illinoisan Building An Airship

Ingenious New Construction to Enter St. Louis Aerial Races

An Illinoisan is the latest to enter the contest for the $100,000 prize offered the winners of the St. Louis world's fair aerial races. William Reiferscheid, of Streator, Ill., has built an airship which he thinks will outclass those of Santos Dumont and

Balloon of Reiferscheid Airship

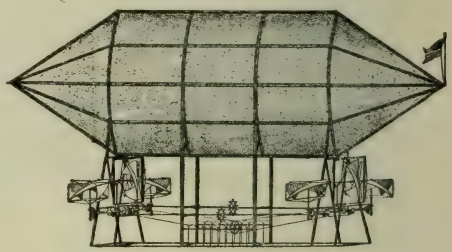
all the other aeronauts, for he says his ship will do more than any of them. It will fly at will in any direction desired; turn, lower and raise in the air at the guidance of the operator. The device consists of a balloon and framework below supporting six shiftable propellers, a car and the motive power. In describing the construction of his machine, Mr. Reiferscheid says:

"The ship's frame is 30 feet long by 8 feet wide. Six 4-feet propellers drive the ship; the four on the sides pull up, down,

Propellers of Reiferscheid Airship

forward and backward, and the two center propellers steer the ship, turning it on the spot or in any circle desired. The balloon is 75 feet long by 25 feet in diameter, with a lifting capacity of 1,680 pounds. The ship, motor and balloon weigh 1,200 pounds. The frame of the ship is built of Shelby steel tubing; the propellers are aluminum; every journal is ball bearing.

"My greatest difficulty has been in securing the proper motive power. I am now having a rotary gasoline motor built, which will weigh 200 pounds and will give me twenty-five horse-power. My present motor is of eight horse-power and weighs 250



Sketch of Design of Reiferscheid Airship

pounds. My new motor can also be used for steam power. I believe it is the simplest and most powerful motor ever built. Necessity is the mother of invention. When I found that I could not get what I wanted through other sources, I resolved to make one myself, and I have succeeded beyond my expectations."

NODIUM IS LIGHTER THAN ALUMINUM.

A new metal, resembling aluminum, but of lesser weight, has been discovered by Albert Nodon, the French engineer, and after him called "nodium." The metal is manufactured by an electric process. In color, lustre and structure it is almost exactly like steel. When molten its specific weight is only 3.4. Its resistence against breaking is given at about 20 pounds per square of 0.04 inch. Its constancy in the air is higher than that of aluminum. Its ductility is between 6 to 8 inches; its malleableness can be compared to that of bronze It melts at about 600 degrees. It is suitable for being cast into forms. The conductibility for electric current is as high as that of copper of equal weight.

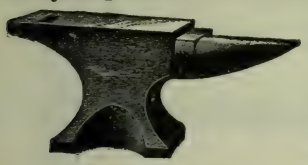
A subscriber in the South writes us that money is so free in Texas that dogs are wearing gold-buckled suspenders to keep up their pants.

First Lessons in Blacksmithing

Every young man, no matter what his intended occupation or profession, should know something about forging, welding a d shaping metals. The work is at once fascinating, useful and practical. This series of articles will extend through several issues.

PART I.—TOOLS AND MATERIALS.

During the summer months of "vacation," when the other fellows are busy with sports, the young man who is mechanically inclined will find both pleasure and profit in a few hours spent at the forge, learning the principles of welding and forming. The knowledge gained by these "tinkering times", be it ever so little, may be of great benefit later in life.



Anvil

The first thing to consider will be the necessary tools such as a forge, anvil, etc., the expense of same, and a suitable room in which to work. A room or corner of a room can usually be found in some out-building or shed, or a small "lean-to" consisting of a roof and sides can be built against another building. The principle requirements of the room or building are a tight roof and plenty of light.

The equipment of tools may consist of only the necessary forge and anvil, or a larger and better assortment, according to the condition of the young man's pocketbook. A fairly good assortment of tools and sufficient materials to commence work with can be had for $25, as follows:

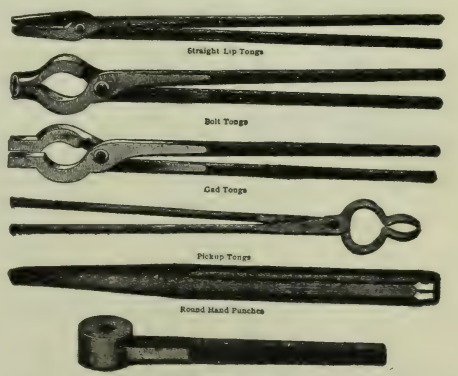
One 100-lb. anvil	$ 9.00
One Champion lever forge, 18-inch hearth, 8-inch fan	7.00
One 3½-inch jaw machinist's vise	4.50
One hardy, to fit in anvil	.30
One 1-lb cross pene machinst's hammer	.50
One 2-lb. ball pene machinst's hammer	.75
Two pairs blacksmith's straight-lipped tongs	.75
One 10-inch flat mill file	.15
One 10-inch flat bastard file	.20
Three or four lengths of second-hand stovepipe for forge	.25
100 lbs. of soft coal	.30
One bar each ⅜-inch, ½-inch, ⅝-inch round iron	1.30
Total	$25.00

By buying the anvil, forge and vise second-hand the above figure could be reduced to perhaps $15, but it would be best to get some one who knows the value of such goods, to buy them, as second-hand goods are often priced beyond their value.

Besides the above named tools, a few nails and boards for a bench, a pail or keg for a water tub, and two or three boxes will be necessary, which can be obtained for practically nothing. The forge may be set up in any part of the room desired, but about two or three feet from the side of the room, near a window, or where a good light will strike the anvil, will be the best place. Connect the stovepipe with the top of the hood on the forge, and run it out through the roof, or the side of the building. When run through the side of the building, an "elbow" and extra length of pipe will be necessary on the outside to prevent the wind blowing into the pipe and driving the smoke back into the room. The anvil should be set on a strong box or block of wood directly in front of the forge, with the horn towards the left.

Hardy

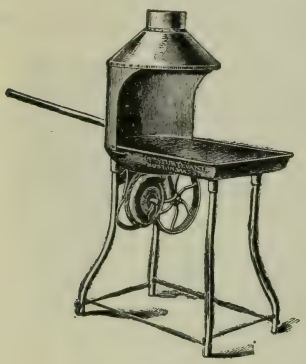
It should be three and one-half feet from the forge, and just high enough so the face of the anvil will touch the knuckles of the hands when standing up beside it.



With a few boards build a bench in any convenient part of the room where there will be plenty of light. It should be from 20 to 24 inches wide, and a little higher than the anvil. About midway, securely fasten the vise with screws or bolts.

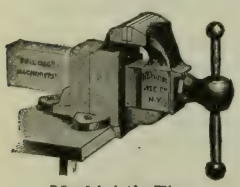
Place a box on the floor near the forge for a coal bin, and another box on end to the right of the anvil for a stand, on which to place the hardy, hammers, etc. A pail or keg near the forge should be filled with water for a cooling tub. The bars of iron should be stood on end in a corner, or laid on the floor near the wall.

A common fire shovel will be necessary to shovel the coal, and a poker and pointed rod for stirring up the fire, which can be made by the young man himself. About two quarts of fine coal ashes should be dumped in the fire pot of the forge, and the hearth filled up with coal. Good coal for blacksmithing should be free from dirt and small stones, and is preferable if in small lumps about the size of a hen's egg, as anything fine like sweepings usually contains more or less dirt. The coal should also be free from sulphur, and any lumps looking yellow should be thrown out. Good coal looks bright and shiny; and will "coke" (swell up and spread apart), when burning.



Portable Forge

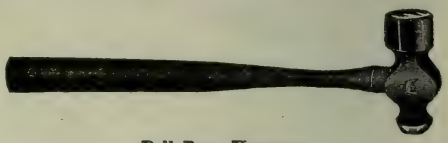
Before starting the forge, if a new one, an oil cup filled with good machine oil should be procured (costing perhaps 25 cents), and the bearings of the fan and drive wheel under the forge hearth oiled, and kept oiled to prevent heating and sticking. Oil these parts often, using only a few drops at a time, as too much oil is nearly as bad as not enough. To start the fire in the forge, shovel out the coal ashes in the center of the fire pot until the air slots in the "tuyere" are reached, throwing away the ashes shoveled out. Fill up the space with dry pine shavings, and touch a fire; when burning in good shape draw up the coal around the shavings, blowing gently until the coal begins to burn, then more coal can be drawn up, and more blast given it until the fire is thoroughly made.



Machinist's Vise

The fire being ready, the two pokers will be the first to make, as they are a necessity to keep the fire in shape. With the hardy in the anvil, cut off two pieces of ⅜-inch round iron two feet long, which can be done without heating. Place one end of one piece in the fire and heat until the end is white hot; bring it out to the anvil and hammer it out to a square point tapering back about one inch; when to a square point, hammer down the corners, which will make a round point, and it is done.

Heat one end of the other rod back for three inches to almost a white heat, and hammer out flat for fully three to four

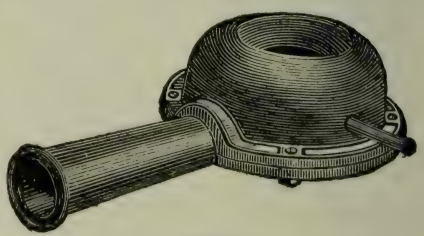


Ball Pene Hammer

inches, to about ⅛ inch thick, cutting the corners off the end with the hardy to make it pointed. At the base of the flattened part bend it well back, then bend the point forward gradually, making a half circle, which makes a first class poker.

The pokers made, the next step will be how to run the fire, and keep it in the best condition. The coal which is burning will soon burn away as the fire is used, and more coal must be put on to take its place. The best way to do this is to keep a good supply of fresh coal drawn up around the fire, and as the fire is used, that which has coked can be pulled over into the fire, thereby keeping a supply of coal constantly in the fire. As the coal burns away, more or less settles to the bottom of the fire in the form of a hard cinder, which should be cleaned out quite often by means of the sharpened rod.

To do this, poke back the live coals to each side of the fire, and lift out the pieces

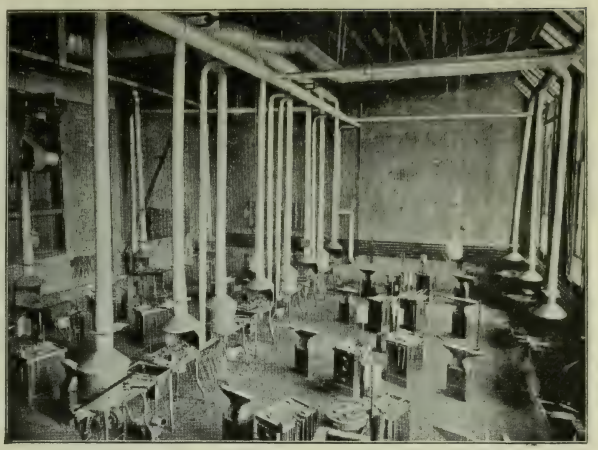


Tuyere

of cinder which are quickly recognized by their weight and hard, ringing sound, draw the coals back in place and the fire is ready to use. Coal on the forge should be kept

sprinkled with water to keep down the dust and to prevent the fire from spreading out and covering too large a surface. The important point to remember in running the fire is to keep it well banked up, and the heat concentrated to the center. A flat, shallow fire is a poor fire for an expert smith to do anything with, much less a beginner.

In the next chapter we will take up heating, forming and welding.



Forge Room, Manual Training School, Cambridge, Mass.

USE OF WOOD ALCOHOL FOLLOWED BY BLINDNESS AND DEATH.

Inhalation of the fumes of wood alcohol while shellacking in a closed room for several days in succession has caused a number of deaths, while through various other means the number of fatalities from poisoning with wood alcohol is increasing. Blindness, too, is another of the terrible effects of this chemical when taken in large quantities, although it varies greatly in different individuals, there having been cases in which two ounces caused death.

The fact of the matter is that, despite the drug's known harmful effects, manufacturers use it in order to put cheap essences, alcohols, etc., on the market. The revenue tax on grain alcohol is $2.17; on wood alcohol there is no tax, and it may be had at 50 cents per gallon. This is a great temptation to the manufacturer. Many of the deaths from wood alcohol poisoning have been after a spree on either lemon essence, Jamaica ginger, or cheap alcohol. The body excretes the poison very slowly, the victim drinks all he can get so long as he is able, the poison accumulates; the system cannot overcome its effects. The result is blindness or death. Sometimes blindness does not result until several days after recovery from intoxication, on the other hand death has followed in 24 hours.

The uses of wood alcohol are many. It enters into the manufacture of ether, formaldehyde, chloroform, methyl chlorid and shellac varnish; it is used extensively in the arts and in many extracts, but taking any great quantity of any liquid containing it should be avoided. It has a sharp burning taste, but an agreeable odor; burns with intense heat and a bluish flame.

EARN YOUR FORGE YOUR TOOLS

Necessary to use in the series of lessons on blacksmithing. The outfit need not cost you any money. To encourage our readers to take up this branch of manual training, the publishers of POPULAR MECHANICS have arranged to purchase anvils, forges and all necessary tools at manufacturer's prices. and these are offered for small clubs of new subscribers to this magazine. The articles are all strictly first-class and will last for years.

Skin Diseases

If you suffer from Eczema, Salt Rheum, Ringworm, Itch, Acne, or other skin troubles,

Hydrozone

will cure you.

As these diseases are caused by parasites, killing them without causing injury to the healthy tissue cures the trouble. It has cured many cases pronounced incurable and is absolutely safe.

Hydrozone is a scientific Germicide. Used and endorsed by leading physicians. It is absolutely harmless, yet a most powerful healing agent.

Trial bottle at your druggist or by mail on receipt of 25 cents. None genuine without my signature on label.

Prof. Charles Marchand

L 63 Prince St., New York

FREE—Valuable Booklet on How to Treat Diseases

SEE SPECIAL OFFER

ELSEWHERE OF OUR NEW BOOK

"Popular Mechanics Shop Notes"

JUST OUT

ELECTRICAL and MECHANICAL **ENGINEERS**

Designers and Builders of Machinery

DRAWINGS FURNISHED. CORRESPONDENCE SOLICITED

WINN, MILMOE & PORTER Stock Exchange Building CHICAGO, ILL.

Dehorn the Calves

WITH THE

HUMANE DEHORNING STICK

A chemical preparation. Better than clipper, knife or liquid.

Price $1.00 per stick Postpaid

Full directions with each package.

E. G. SHERMAN
Dept. D
99 Randolph St.
Chicago

ENGLISH ROADS MAKE UNSATISFACTORY SHOWING.

The half-yearly reports of the principal English railways show that they have not experienced the remarkable prosperity enjoyed by American roads. For the last six months of 1903, compared with the same period of 1902, eight out of twelve main English systems reduced their dividends from ¼ to ½ per cent, while only four of them pay above 6 per cent and only six above 4 per cent.

The passenger traffic, according to English critics, shows a gratifying increase, but the freight receipts fell off severely. The introduction of electric tram cars, bad weather, general commercial depression and heavy taxation are the main causes cited by the British for the rather unpropitious year for English railways. At a recent meeting of the Great Western stockholders a resolution was introduced declaring that the enormous increase in expenditures over the increase in receipts made a consolidation of the leading roads of England necessary that material economies might be effected.

ELECTRIC CAR AIDS IN SAVING LIFE.

The arc headlight of an electric car was of great assistance recently in saving the crew of a lumber schooner which had anchored off the beach at Redondo, Cal., and, her chains breaking during the night, was blown on shore. The car was run to a position from which its light was thrown on the vessel and heartened up the crew magically, and also expedited the matter of getting a line to them, by which the rescue was effected by the life saving crew.

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

NORTHWESTERN ELECTRIC CO.

NEW AND SECOND-HAND

DYNAMOS & MOTORS
WATT-METERS

GUARANTEED ELECTRICAL REPAIRS

Switchboards Built to Order.
Switchboard Instruments Recalibrated. Watt-Meters Changed to Operate on Any Number of Cycles.

69 West Washington St., CHICAGO, U. S. A.

Telephones...

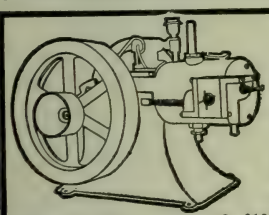
For Farm and County Lines.

Every Instrument Guaranteed.
A Full Line of Supplies.

GET PRICES

EMPIRE ELECTRIC SUPPLY CO.

55 West Jackson Blvd. CHICAGO, ILL.



1-4 H. P. Gas Engine

Castings for **$15** up

with blue prints. Cylinder bored out and faced off.

Runs by gas or gasoline. Water Jacketed. 1-2 H. P. astings, not bored or faced, $16.00. Send for catalog of engines, dynamos, electrical supplies.

L. W. GILLESPIE & CO., 218 E. 4th Street, MARION, IND

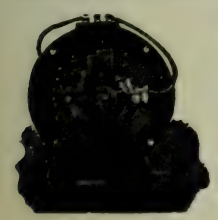
GASOLINE TANKS

FOR AUTOMOBILES, MOTOR CYCLES AND ENGINES

RADIATORS for Automobiles.
MUFFLERS for Motor Cycles.

Only first-class work.
Prices reasonable.
Satisfaction guaranteed.

EDW. C. FISCHER, Mfr.
977 Bradley St., ST. PAUL



Peerless Electric Co.

ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET

141-143 South Clinton Street
'Phone Main 1025 **Chicago**

THE PARACHUTE MAN—HIS FIRST ASCENSION.

"Come on! The band's all ready."

I was met with a roar of applause as I ran down the hotel steps. The band blared in salute, and the crowd opened up for me as I hastened. The parachute was stretched out from the straining balloon. As the man with me snapped the hooks on the ring, he showed me where the rope hung, and told me how to pull it when cutting loose. He was the excited one. I was in a semi-stupor. A bitter indifference filled me as I looked at the ugly, swaying monster which was to bear me to affluence or death.

"Let her go!"

With a cleaving of the air and a rush of sound like the coming of a cyclone, the balloon shot upward. I ran for the bar, grasped it and soared.

I tried to swing up on the bar. But the rush of the ascent straightened me, like an iron rod. I thought my arms would be pulled out. A sickness came over me, comparable to the effect of the start made by a high-speed elevator. Then the motion became more easy and I swung up on the bar. I was accustomed to gazing down from heights, and felt no fear as I stared at the fading crowd. I could see them waving hats and hands; could hear the band playing; and was conscious of a pleasant, dreamy sensation, and of a steady, easy rising from the ground. I ventured to bend a "crab" and make a few "ankle drops." It was as easy as when I was only a few feet from the ground. I glanced down again. The crowd appeared smaller and seemed to be walking away from me. I had commenced to drift. Now was the time to cut loose. I wished that I might stay where I was—taking chances with that limp bag of a parachute did not look to be safe. But it had to be done.

I caught hold of the rope, braced myself on the bar, and gave a short, hard pull.

Whish—my breath left me! For the first time fear—deadly fear—entered my heart. A jerk that nearly unseated me, and I was again sailing pleasantly through space.

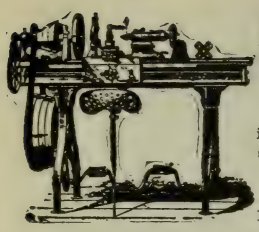
I ventured to essay a few additional feats, as the ground seemed to more closely approach me, and then I commenced to calculate as to the manner in which to strike the ground. Like many other problems, it settled itself. I struck it feet first in a corn field; was dragged along and scratched up, and came to consciousness in the arms of my new manager, who was alternately cursing me for getting killed and blessing me for having saved his skin and the four hundred and fifty dollars.—Outing.

FROGS LEAVING MINNESOTA.

The raising and catching of frogs is quite an industry in Minnesota. Last year 5,000,000 frogs were marketed valued at $100,000. The legs are put in cold storage in St. Paul and shipped out to all parts of the country. Owing to the clear, pure waters of the Minnesota lakes the flavor of the frogs caught there is said to be unequalled.

CLOCK CALLS OUT FIRE COMPANIES.

A fire alarm sounded in lower New York and continued with such an ominous clamor that other alarms took up the blatant message and citizens aroused in fear. It was a clear, cold night in January of 1848. Several fire companies hastened to their duty and soon were speeding madly down Broadway. At Trinity Church they paused, for the source of the alarm became evident. The church clock was out of order and had begun to strike and continued striking for about two hours, or until it ran down, the clear, cold night air making it sound especially portentous.



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

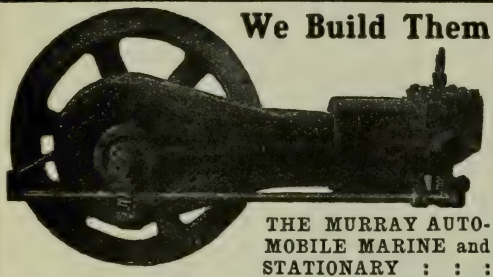
W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

FOOT and POWER

AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

We Build Them



THE MURRAY AUTOMOBILE MARINE and STATIONARY : : :

GASOLINE ENGINES

Transmission, Gears, Carburetters, Pumps, Mufflers, Etc
Write for Circular and Prices before ordering.
W. B. MURRAY, 1253 Milwaukee Ave., Chicago

KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago.

Sparking Motors Cured

By using

Peerless

Commutator

Compound

SAMPLES FREE

PEERLESS MANUFACTURING CO.
844 Common Street, New Orleans, La.

A special oven for glass making which burns less than half the amount of coal that the old ovens did has been invented and is in use in France. Manufacturers desiring further particulars should address Desire Jauffret and Francois Chiapponi, care of Vincent Haour, Pont Magnan, Nice, France.

JAPAN'S SEA TRAINING.

In the eleventh or twelfth century the Japanese were the most dashing pirates of the East—in fact, we might almost call them the Vikings of the East. They used junks—small ships with a scrap of sail, about the size of the little vessels in which the Danes once raided our own coasts. With these junks the Japanese roamed the seas, going everywhere along the Chinese main, ravaging the coasts, trading, and bringing home priceless works of art from China.

It was not until long afterward that the ruling authorities of Japan, under the great Emperor Hideyoshi, decided that it suited their purpose to shut off communication with the outside world and to live to themselves, trading merely with their own islands. The old Japanese Vikings were reduced to simple fishermen and the period of internal feudatory wars began, for at that time, at least, Japanese would fight because they loved it.

WHAT YOUR WEIGHT IN GOLD AMOUNTS TO

When it comes down to actual figures few people are not worth their weight in gold. The fact is that one $5.00 goldpiece weighs only about six and one-half times as much as one $1.00 bill, or .296 ounce avoirdupois, a $1.00 bill weighing .045 ounce. Very few people but estimate the weight of money wrong. In silver, of course, the weight is much greater, 100 pounds of dollars being equal to $1,309; of half dollars $1,818; of quarter dollars, $1,329; of dimes, $1,307.90; of nickels, $458.50, and of pennies, $147.80.

It would really have a greater numerical significance to say a person is worth his weight in paper, specifying the denomination, than to say he is worth his weight in gold.

HOW TO REMOVE STAINS ON DISHES.

To remove developer and other stains from dishes, says Photo Beacon, mix some salt with enough water to form a sort of paste, and rub the stains with this mixture with a piece of cloth. If the stains are of long standing, and this fails to remove them, rub the salt into the stains with a piece of pumice stone. This will remove any stains of any substance such as hypo, pyro, etc.

PATENTED A HOLE.

A hole in the end of a toothbrush handle once brought thousands of dollars to the sharp fellow who patented it. A little hook was given with each brush with instructions to hang up the brush, and the toothbrushes so provided sold higher than others just like them with the exception of the hole.

The patent has expired, however, and holes may now be put in the handles of brushes of any make.

BOYS' CLUB BEING ORGANIZED.

A club for boys interested in photography, electricity and other sciences is now being formed, more especially for boys living in Chicago on the South Side. Parties interested should address W. I. Wilcox, 4244 Langley avenue, for information.

A gentleman riding with an Irishman came within sight of an old gallows, and to display his wit, said:

"Pat, do you see that?"

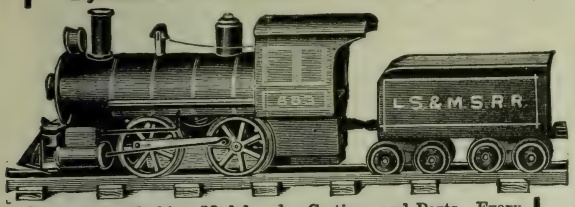
"To be sure Oi do," replied Pat.

"And where would you be today if the gallows had its due?"

"Oi'd be riding alone," replied Pat.

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



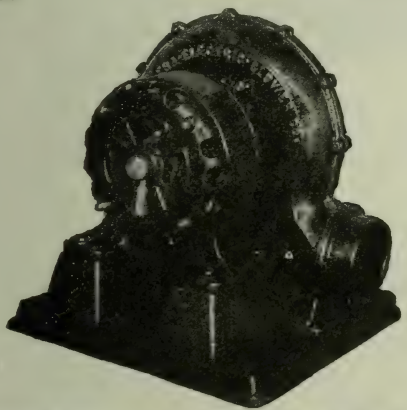
Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio

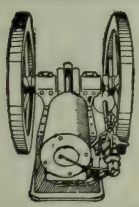
NEW ERA ELECTRIC BLOWER

Direct connected, has been designed especially for the blacksmith, and it is his ever ready helper that works for less than five cents a day, and never tires. It places him on an equal footing with the largest steam shops and allows him to work steadily at the anvil while his work is being "electrically" heated.



WRITE FOR CIRCULAR AND PARTICULARS

NEW ERA ELECTRIC CO., 942 W. Lake St, Chicago



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

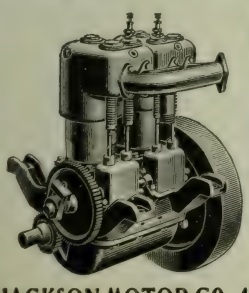
LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY

25 West Randolph Street, Chicago

DOUBLE CYLINDER



Gasoline MOTORS

4½ BORE. 5½ STROKE

12 H. P.

Simple—Reliable.

Write us for full particulars and prices

JACKSON MOTOR CO. 43 N. Union St., Chicago

WHAT 3 PER CENT A MONTH DOES.

A merchant once said to Peter Cooper, that he was about to borrow $10,000 for six months at 3 per cent a month.

"Why do you borrow for so short a time?" Mr. Cooper asked. "Because the brokers will not negotiate bills for longer." "Well, if you wish," said Mr. Cooper, "I will discount your note at that rate for three years." "Are you in earnest?" asked the would-be borrower. "Certainly I am. I will discount your note for $10,000, for three years at that rate. Will you do it?" "Of course I will," said the merchant. "Well," said Mr. Cooper, "just sign this note for $10,000, payable in three years, and give me your check for $800, and the transaction will be complete." "But where is the money for me?" asked the astonished merchant. "Your interest for thirty-six months at 3 per cent per month amounts to 108 per cent, or $10,800. Therefore your check for $800 just makes us even."

SUCCESS.

By John Trotwood Moore.

'Tis the coward who quits to misfortune,
'Tis the knave who changes each day,
'Tis the fool who wins half the battle,
Then throws all his chances away.

There is little in life but labor,
And tomorrow may find that a dream;
Success is the bride of Endeavor,
And luck—but a meteor's gleam.

The time to succeed is when others,
Discouraged, show traces of tire;
The battle is fought in the homestretch—
And won—'twixt the flag and the wire!

INVENTIONS TO ORDER.

The Popular Mechanics' Patent Bureau is prepared to furnish designs or working drawings for labor-saving machines of all kinds. It has a corps of one hundred mechanical and electrical engineers of extensive experience in designing and constructing wood-working and metal-working machinery.

Manufacturers who are bothered with mechanical difficulties in their shops or who desire to improve their products or decrease the cost of production, are invited to write us freely, stating their needs. All designs or inventions will be furnished under an agreement by which there will be no charge unless the work is acceptable, and if accepted, all patent rights will belong exclusively to the party for whom the designs are furnished.

A MAN WHO DID THINGS.

The story has been told before, but is worth repeating, especially for younger readers to whom it is new.

T. J. Patter, known to railroad men all over the United States as Tom Patter, was at the time of his death a few years ago, general manager of one of the largest railroads in the world. He was the telegraph operator at a little way station, who one wild night, when wires were down and a passenger train went through the bridge, took charge of the dead, cared for the wounded, settled fifty claims—drawing on the company therefor—burned the wreckage, sunk the waste iron in the river and repaired the bridge before the superintendent arrived on the scene. "Who gave you authority to do all this?" demanded the superintendent. "Nobody," said Tom, "I assumed the authority." Next month his salary was at the rate of $5,000 a year.

Today the finest passenger steamer on the Columbia river bears his name.

Bargains in Supplies

THIS MONTH'S BARGAIN
1000 SPIT-FIRE SPARK PLUGS
Postpaid to any address, 77c each.

LACY BROS. SUPPLY HOUSE
135 ST. CLAIR ST. : : : : : : : TOLEDO, OHIO

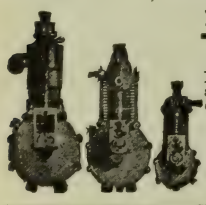
MOTORS

$5.00 Buys a
COMPLETE PRACTICAL BATTERY MOTOR—Not a Toy

WALSH'S SONS & CO.
250 Washington St. - Newark, N. J.

SUPPLIES
DIRT CHEAP
Write for Catalogue and Green Discount
THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago

When You Want Special Jobs Done in Sheet Metal
get in touch with us. We make
Steel Tanks, Conveyor Troughs Hoppers, Trucks, Chutes
In fact, anything of Sheet Steel, Galvanized Iron, Tin or Copper, accurately and promptly at reasonable prices
LYON METALLIC MANUFACTURING CO.
18-20 South Ann St., Chicago.



1 3-4 H. P. Bike Motor $7.50
Castings with Drawings 1904 Model
Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. send for circular to
EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

SPROCKETS
and EQUALIZING GEARS
IN STOCK OR TO ORDER.
Standard makes of Chain carried in stock. Catalogue free.
CULLMAN WHEEL CO., 521-525 Larrabee St., Chicago

Every Bicycle a Motor Cycle

by using one of our ATTACHABLE MOTOR outfits. Thoroughly practical. Can be applied to any wheel. On the market four years. Also Motors and Castings for Bicycle, Automobile, Marine or Stationary. LOWEST PRICES. 2-cent stamp gets our catalogue.
STEFFEY MFG. CO., Brown & Pennock Sts., Philad'a, Pa.

ENORMOUS BALLOON CLOCK A FEATURE OF LEWIS AND CLARK EXPOSITION.

Persons attending the Lewis and Clark Exposition to be held at Portland, Oregon, in 1905, in commemoration of the memorable expedition, will have no difficulty in telling the time while on the fair grounds. A balloon clock having a dial 50 feet in diameter with electric lighted face will be suspended 400 feet above the grounds. A stationary balloon will hold it in place, where it may be referred to at all times from any part of the grounds.

The western fair promises to pass in spectacular review all the unrivaled features of a country where grain, fruits and flowers mature almost perfectly. Aside from the many remarkable exhibits, beautiful buildings and various unique features, the setting of the exposition is hardly to be equaled in America. On the shore of the beautiful Willamette river, in sight of many snow-crowned peaks, notably among them old Hood, and in easy distance of the Pacific coast, the exposition, commemorating an event of national import, is certain to draw a mighty concourse of people.

FISHING FOR SHAD ON THE DELAWARE.

When the fishing season opens up on the Delaware river the scene is one of great activity and interest. Before the great net, two miles in length, for hauling in the shad, can be lowered, all the debris that has collected during the winter months must be cleared away, and many a ghastly relic is brought from the depths while secrets are disentombed and dark mysteries grow darker.

The net is 10 feet deep at the outer edges and 30 feet deep in the middle. It is loaded on a great boat which is rowed out on the river. The captain then instructs the men in another boat where to row for the casting, throws them an edge of the net and pays out all of it as they row away. Then the haulers are signaled and the work of dragging in the net is begun. Seventy-five men and eight horses are required to haul it in. First comes a long rope, then gradually the net comes in sight and the men hold the ropes taut to keep the shad from escaping. Some do escape, the smaller ones through the meshes of the net, others leaping over. The water is lashed into a white fury in their futile endeavor, but slowly, surely, the net approaches the shore and the gleaming mass is seen writhing and struggling in the shallow water. Then the captain, in a boat, goes to the center of the mass and experienced workers pick the fish out by hand and put them into the boat. What few remain are removed when the net is hauled on shore.

The fishermen live in shacks along the river during the season and two casts are made each day.

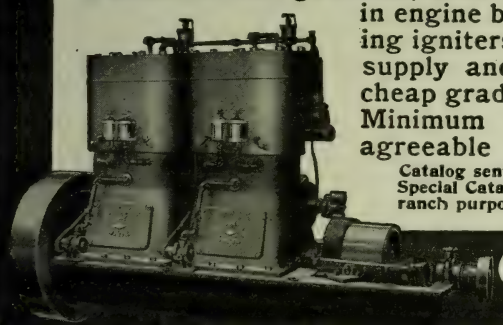
FUEL OIL USED FOR LONG VOYAGE

Nine thousand three hundred barrels of fuel oil were consumed by the steamship "Nebraskan" in a trip of 12,724 nautical miles from San Diego, Cal., to New York, by way of the Straits of Magellan. The long trip tested the economical value of oil as fuel for ocean navigation thoroughly. One of the great differences made by the use of oil was that 12 men were saved from the fireroom and but three were required for tending the burners.

WHITE

GASOLINE MARINE ENGINES

SAFETY demands a marine engine that is absolutely reliable, certain and prompt in starting. White Gasoline Engines are guaranteed to start readily and run satisfactorily under all conditions of weather, and to be free from defects in material and construction. They are of the four cycle type and are designed for long and heavy service. Each engine is fitted with a sensitive ball governor, solid propeller with reversing gears held in engine bed, early and late spark, self cleaning igniters, glass gasoline feed cup showing supply and working of fuel. Distillate and cheap grades of oil may be successfully used. Minimum vibration and noise and no disagreeable odor.



Catalog sent upon request—also estimates on complete launches. Special Catalog of Stationary and Portable Engines for general ranch purposes.

GLOBE IRON WORKS CO.

P.O.BOX 143 K MINNEAPOLIS, MINN.

C D D E E F G G A A B B C D D E A A B B C D D E

Left Hand — Right Hand

You can play Chords on Piano or Organ at once without learning with Collins' Musical Chord Chart. Agents Wanted. Sample 25c. postpaid. Silver or stamps. Sells at $1.50. Western Music Co., P.M. Gen. Life Bldg., St. Paul, Minn.

INVENTIONS PERFECTED

through designing working drawings, and superintended by MECHANICAL EXPERT of wide reputation and practical experience.

GEORGE WEISS, Mechanical Engineer, 614 Omaha Building, CHICAGO, ILLINOIS

$1 BUYS THE GENUINE SALADIN RAZOR

THE BEST RAZOR MADE AT ANY PRICE.

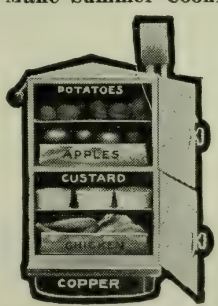
Hand forged from the finest razor steel in the world. Made and tempered by experts, ground by hand, ⅝ inch blade with double shoulder, set ready for use. Fully warranted. We guarantee satisfaction. If the razor we send you is not right EVERY WAY, we replace it until you are completely satisfied. A trial will convince you. Don't pay $3 to $5 for a razor no better or not as good.

Postpaid on receipt of $1.00. Address

HOME MERCANTILE CO., Dept. 24, Grossdale, Ill.

DON'T STAND OVER A HOT STOVE

Make Summer Cooking a Pleasure by Using



O-HI-O Steam Cooker

WITH TWO DOORS

PRICES, $2.50 TO $9.50

ADVANTAGES

1. Cooks entire meal over one burner, any style stove.
2. **Saves 50 pr cent** in fuel.
3. Food CANNOT be burned.
4. Food always steaming hot.
5. Food not spoiled by waiting meal.
6. **Saves 50 per ct. in food**
7. Meats always tender. No evaporation. **Saves 25 per cent. in meat bills.**
8. Steam cooked food always easily digested. Cures dyspepsia.
9. **Saves 50 per cent in doctor's bills.**
10. Cooker once filled will cook entire meal from soup to dessert without further attention. Can't overcook.
11. **Saves 50 per cent in labor.**
12. **Takes the place of a cook or makes a good cook out of a poor one. No mistakes.**

FINE FOR SUMMER COTTAGES

GRAND FOR CANNING FRUIT

Handsomely Illustrated Catalog Free

WE WANT GOOD AGENTS and will guarantee them $30 to 40 per week and expenses. Write now and start in business for yourself before your territory is given to another.

THE OHIO COOKER COMPANY

759 Jeff Avenue, Toledo, O.

MODELS & GEARS
CATALOGUES FREE
UNION MODEL WORKS
193 CLARK CHICAGO.

F. D. CROFOOT N. NIELSON
BLUE PRINTING BY ELECTRIC LIGHT
BLUE PRINTERS BLUE PRINTING, BLACK PRINTING, BLUE LINE & COLOR PRINTING
WRITE FOR PRICES.
CROFOOT, NEILSEN & CO.
167-169 E. Washington St. - - CHICAGO

MODELS AND SUPPLIES
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Avenue, Chicago

A NEW BOOK FOR MECHANICS
Johnson's "Handy Manual" for Plumbers, Steamfitters, Gasfitters, Engineers, Tinsmiths.
and exceedingly useful for Mechanics in any of the trades using pipes and fittings. The book contains tables of measurements of all kinds, is profusely illustrated, teaches how to figure on and construct Steam and Hot Water Circulating Plants of all descriptions, tells all about the most modern and improved methods of plumbing and gasfitting; in fact what the "Manual" does not contain about pipe work is not worth knowing. A table of 45 degree measurements from 1 inch to 20 feet is alone worth the price asked for the book. Mailed postpaid upon receipt of $1.00.
JOHN W. JOHNSON, 802 Stewart Building, Chicago

MODELS CHICAGO MODEL WORKS
179 E MADISON ST., CHICAGO, ILL.
ESTABLISHED 1867 WRITE FOR CATALOGUE OF MODEL SUPPLIES

AUTOMOBILE PARTS
OF EVERY DESCRIPTION.
Write for Catalog and Prices.
OTTO KONIGSLOW,
CLEVELAND, OHIO

SPECIAL MANUFACTURING
Dies and Stamping
--TO ORDER--
SPECIAL MACHINERY, MODELS EXPERIMENTAL WORK
DROP FORGING DIES AND DROP FORGINGS
Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.
THE GLOBE MACHINE & STAMPING CO.
973 Hamilton St., - Cleveland, Ohio

HINTS FOR INVENTORS.

By Frederick Benjamin.
(Copyright 1904.)

THE INS AND OUTS OF PATENTS.

As the sixteenth century was the age of art, the twentieth is the age of invention. But our Raphaels and Michael Angelos of science do not work for fame; they are after money. And to get money from an invention it must be patented. Here is where many an ingenious idea, that could materially lighten the labor of the world and bring reputation and profit to its originator, is stranded, and despite the popular notion to the contrary, the inventor is usually his own worst enemy.

WHO CAN OBTAIN A PATENT.

Who may obtain a patent and the nature of the patentable invention are defined by the U. S. Revised Statutes, Section 4886, as follows:

"A patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof not known or used by others in this country, and not patented nor described in any printed publication in this or any foreign country, before his invention or discovery thereof, and not in public use nor on sale for more than two years prior to his application, unless the same is proved to have been abandoned."

WHAT MAY BE PATENTED.

The Revised Statutes of the United States provide that a patent may be obtained for "any new and useful art, machine, manufacture, or composition of matter, or for any new and useful improvement thereof."

Under this provision of the statute patents are granted for seventeen years:—

1. For any new and useful machine, manufacture, or composition of matter.
2. For any new combination of mechanical parts or instruments, whereby a new machine is produced, though each of the parts be separately old.
3. For an improvement in any known machine or article of manufacture, whereby it is rendered capable of working more beneficially, or its manufacture is cheapened.
4. For any new and useful process not wholly mechanical.
5. For a new vendible substance, new or improved in itself, whether produced by a chemical or a mechanical process.
6. For new improvements in any manufacture, composition of matter, or any art.

To be patentable a thing must be new and useful within the meaning of those words as used in the law, and it must also involve the quality of invention, as distinguished from mechanical skill.

HOW TO MAKE INVENTIONS.

To invent is to think. Inventions are ideas in physical shape or practical application. Anyone who can think, can invent. The power of inventing increases with exercise.

Accident frequently suggests new ideas, but the complete invention is usually the result of concentrated thought, careful investigation and persistent experiment.

An inventor, to attain the greatest success, must study his invention, no matter how simple it is. If he adopts invention as a profession he must study the subject as a lawyer studies law, the doctor medicine, or the engineer engines. He should first study the needs of the public, beginning with the simple ones, then find out the existing difficulties in the art or industry to which the need applies, and then strive to overcome these difficulties.

Pay no attention to lists of so-called "inventions wanted." There is always room for improvement

HOW TO MAKE

Electrical Instruments

Chapters of "Easy Electrical Experiments," which have been printed in Popular Mechanics as a serial, are for sale to close out all back numbers. All the chapters are complete, describing the instrument named in the list below. Sent postpaid on receipt of price.

Thousands of Popular Mechanics' readers have made these instruments from the descriptions which are given in plain, simple language, "written so you can understand it." Directions are fully illustrated. Money (or stamps) must accompany order.

TELLS HOW TO MAKE

No.	Parts.	Cents.
1—Simple Galvanometer	1	5
2—Box to Hold Battery	1	5
3—Tangent Galvanometer	1	5
4—Powerful Magnet	1	5
8—Measurement of Resistance	2	10
9—An Electrophorus	1	5
10—Electric Condenser	1	5
12—Rheostat	2	10
13—Electric Bell	3	10
17—Electric Gyroscope	3	10
18—Electric Locomotive	2	10
19—Model Fire Alarm Telegraph	2	10
20—Electric Bomb	1	5
21—Automatic Circuit Closer	1	5
22—Electrically Lighted Lamp	1	5
23—Simple Arc Lamp	1	5
24—Experimental Battery	1	5
25—Portable Voltmeter	3	10

1904	Price.
Jan.—An Ammeter for Electro Platers	$ .10
Feb.—A Simple Electric Lamp Outfit	.10
Mar.—A Duplex Telegraph Instrument	.10
Apr.—A Thermo-Electric Generator	.10
May—A Simple Electric Engine	.10

Other articles for boys tell How to Make.

1904	Price.
Jan.—Devices for Winter Sports	$ .10
Feb.—Coasting Sleds, Chair Sleighs, Toboggan Slides, and Skis	.10
Apr.—Your Own Fishing Tackle	.10
May—A Paper Boat	.10

Address

POPULAR MECHANICS
Journal Bldg., Chicago

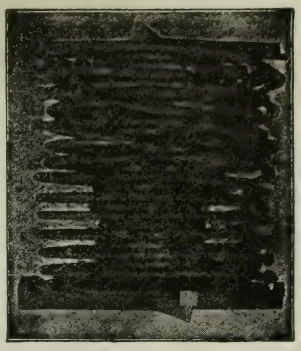
SEND FOR

Popular Mechanics PREMIUM LIST

JUST OUT

Our New **FLASH BOILER**

For 1904



No burning of boiler—No water gas—No smoke. Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

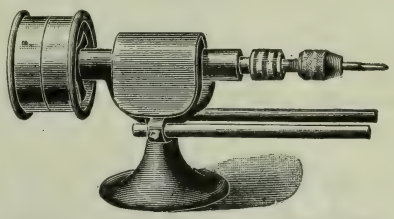
Condensers, and other appliances are marvels of mechanical development.

Barton Boiler Company

SOLE MANUFACTURERS,

4230 State St., Chicago, Ill., U. S. A.

Write for full particulars



This Sensitive Drill requires no counter shaft. Belts at any angle; self starting; rapid work up to 5-16 inches Reverse motion tapping machine unexcelled for tapping of light work. Bottoms without breaking taps. No countershaft required. *Send for circular.*

A. E. FABER, Jr., Plainfield, New Jersey.

No. 10 Double Jet Blow Pipe
Capacity 3-4 pints. Weight 2 lbs.

Needle Flame

Over 3000°

The Turner Double Jet Alcohol Blow Pipe No. 10

Has the nearest approach to the Oxy Hydrogen Blow Pipe Jet invented and is made so compact it can be carried in the pocket. The fuel is wood alcohol and it will run 3 hours at full blast from one filling. The flame is non-oxidizing and can be regulated from a needle point to a brush flame. Unexcelled for jeweler's and optician's work, fine brazing and soldering.

LABORATORY AND EXPERIMENTAL WORK AND LEAD BURNING

SEND FOR CIRCULAR

The **TURNER BRASS WORKS**

55 North Franklin St., Chicago

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to any one having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building . . WASHINGTON, D. C.

PATENTS

promptly obtained OR NO FEE. Trade-Marks, Caveats, Copyrights and Labels registered. TWENTY YEARS' PRACTICE. Highest references. Send model, sketch or photo. for free report on patentability. All business confidential. HAND-BOOK FREE. Explains everything. Tells How to Obtain and Sell Patents, What Inventions Will Pay, How to Get a Partner, explains best mechanical movements, and contains 300 other subjects of importance to inventors. *Address,*

H. B. WILLSON & CO. Patent Attorneys
721 F Street West. WASHINGTON, D. C.

W. H. Stevens
(Estab. 1867)
Solicitor of American and Foreign
PATENTS

Honest advice; honest service. My record—97 per cent. successful cases. Booklet free.
1065 Virginia Ave. -- WASHINGTON. D. C.

PATENTS
Protect Your Ideas
Consultation Free
Fee Dependent on Success
Established 1864
MILO B. STEVENS & CO.
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

TYPEWRITERS ALL MAKES
All the Standard Machines Sold or Rented Any Where at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g Typewriter Emporium, 196 La Salle St., Chicago

in every industry, and there is ever a demand for new industries, so that the field of the inventor is without limit. The inventor should note the work done by hand and try to think of a way to do it automatically or by machine. He should consider the cost of the tool or machine or process, and try to think of a way to reduce the cost without impairing the quality. He should observe the product of an industry and see if it cannot be increased or improved. He should apply his thoughts to the problems of saving life, or property, or waste, or power, or time, or distance. When he has an idea which he thinks is new, he should put it in form of a working drawing or model, then study it with a view of making it stronger, or simpler, or cheaper, or in some way better. He should not get discouraged if he does not succeed at once or attain perfection. The world's greatest inventions were not developed in a day. In the beginning they were the crude embodiments of great possibilities, and now, after many years, they are not all perfect.

A patentable invention may be made by omitting one or more parts of a machine, or by changing the position of the parts, or by combining two devices in one, if by such changes a better result is accomplished.

An inventor should not give up because his invention turns out to be old. The fact that some one else has thought of the same thing is a compliment to his inventive powers. If he can invent one thing he can another. In conclusion, give your best thoughts and efforts to your invention, and nine times out of ten you will succeed.

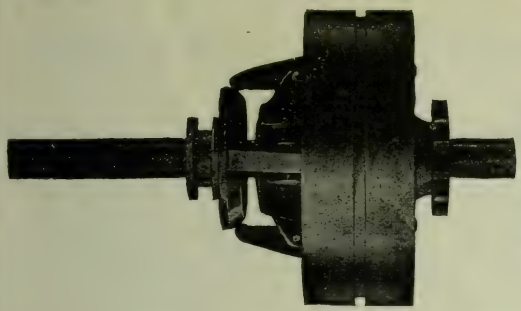
United States Senator Platt, of Connecticut, in a speech in support of the Patent Laws stated that "two-thirds of the aggregate wealth in the United States is due to patented inventions." This is certainly not an extravagant estimate.

THE PATENT APPLICATION.

The Patent Office will take no notice of any device unless presented in a complete formal application, which includes, where admissible, a drawing made in conformity with certain rules and regulations, a clear and concise specification from which a skilled mechanic would be able to construct the device, and a condensed statement of the invention in the form of claims embodying what is thought to be its novel features; the whole attested by a duly acknowledged oath. In the specification should appear the advantages and conveniences to be secured by the invention in addition to a description by reference letters or numerals of the parts of the device, together with their co-operative relationship and interdependency. It is rarely possible that an inventor

MACHINERY BARGAINS
SEND FOR MY PRINTED PRICE LIST OF
Automatic and Slide Valve Engines, Hoisting Engines, Boilers, Heaters, Air Compressors, Rock Drills, Crushers, Locomotives, Steam Shovels, Pile Drivers, Dump Cars, Dredge Machines, Traveling Derricks, Cableways, Concrete Mixers, Coal Mine Hoists and Machinery Generally. I handle both New and Second-hand.
WILLIS SHAW, - - - - 171 La Salle St., CHICAGO

Please mention Popular Mechanics when writing advertisers.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

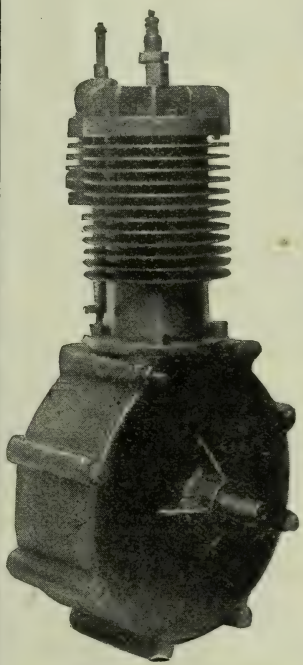
Successors to THE P. J. DASEY CO.

1339 Michigan Blvd. Chicago, Ill., U. S. A.

BIG 4
The "Way of the World" to the World's Fair
BIG FOUR ROUTE
TO ST. LOUIS-1904
WRITE for FOLDERS and BOOKLETS
M. E. INGALLS, Pres.-CINCINNATI-WARREN J. LYNCH, G. P. & T. A.

3 Horse-Power, Air-Cooled

Bicycle ENGINE



Bicycle Engine 1 to 4 cycle, Air or Water-Cooled—1¼ to 30 H. P.

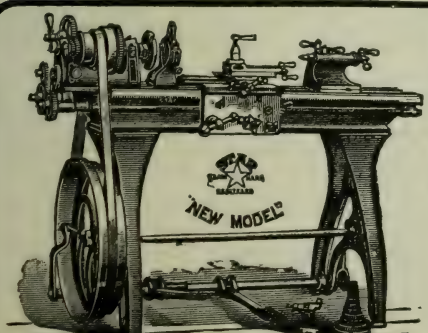
Bicycle Motors, Auto Supplies, Accessories and Castings for Bicycle Motors:::

W. HOFFMAN MOTOR WKS.

1253 N. Halsted Street

Chicago, Ill.

Weight, 70 lbs. Bore 3-4 in. Soke, 3 1-4 in.



9 and 11-inch "Star" Foot Lathes.
9, 11, 12 and 14-inch "Star" Power Lathes

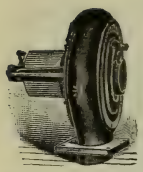
STAR LATHES Foot and Power...

High-grade screw-cutting engine Lathes, with forged crucible steel hollow spindles, phosphor bronze bearings, gear-driven reversible feeds with strong friction drive in apron, our patented spring nuts which allow quick shifts of change gears, also Draw-in Chuck, Gear-cutting, Milling and Taper Attachments if desired.

Suitable for electrical and repair work, model makers, gunsmiths, technical schools and fine, accurate machine-shop and tool-room service. Ask for COMPLETE DESCRIPTIONS.

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N. Y., U. S. A.

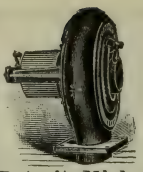


WATER MOTORS

¾ to 15 H. P.

for Ice Cream Freezers, Coffee Mills, Churns, Printing Offices and small Electric Light Plants, etc.

Electric Motors and Generators, Combination Water Generator for charging storage batteries. Send stamp for circulars.



C. S. PIPER & CO., Detroit, Mich.

THE WINGET **CONCRETE BUILDING BLOCK MACHINE**

Automatic Adjustable

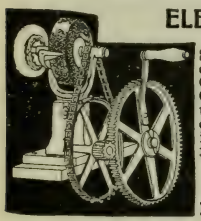
Makes any size or shape block required in ordinary building operations

Straight & Corner Block

A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

CHEAP RATES California, Washington Oregon, Colorado. We secure reduced rates on household goods of intending settlers to the above states. Write for rates. Map of California FREE. TRANS-CONTINENTAL FREIGHT CO., 329½ Dearborn st., Chicago

---



ELECTRIC DIAMOND GRINDER

Shipped on 10 days FREE TRIAL, 3,000 revolutions per minute. Only Hand Power Grinder with CARBORUNDUM wheels. Cuts eight times faster than emery, twenty times faster than sandstone. Will not draw temper. Try it FREE. If not satisfactory return at our expense. If satisfactory remit us $4.50.

LUTHER BROS.

Dept. P. M. North Milwaukee, Wis.

JOHN KIOLA, General Engraver

Seals, Badges, Steel and Brass Stamps, Embossing Dies, Etc,

Drop a Postal for Free Booklet

R. 59, 155 W. MADISON STREET, CHICAGO, ILL

MARK YOUR NAME on your TOOLS, etc.

Price per letter for Steel Stamps		
SIZE OF LETTERS	INITIAL STAMP	NAME STAMP
1-16 in.	18c.	14c
1-8 in.	18c.	14c.
3-16 in.	23c.	18c,
1-4 in.	35c.	28c.

SEALS $1.70 WITH A **Steel Stamp**

WILLIAM SCHRIDDE,
Engraver and Die Maker
35 S. Clark St. Chicago, Ill.

C. H. HANSON
MANUFACTURER OF
MACHINE PLATES
44 SO. CLARK ST.
CHICAGO

NAME PLATES, STEEL DIES
SEALS and STENCILS

C. H. HANSON, 44 So. Clark St.
Chicago

can properly prepare his application and comply with all the intricate legal requirements. In view of the fact that through inexperience valuable features of inventions were often left unclaimed, and therefore unprotected, the United States Supreme Court has embodied the following warning to inventors in one of its decisions:

"The growth of the patent system in the last quarter of a century, in this country, has reached a stage in its progress, where the variety and magnitude of the interests involved require accuracy, precision and care in the preparation of all the papers on which the patent is founded."—Merrill v. Yeomans, U. S. Supreme Court.

There is only one way in which this accuracy, precision and care can possibly be secured, and that is by the employment of a trustworthy and experienced attorney. The inventor who is applying for his first patent is absolutely certain to blunder if he tries to make out his application himself. He may describe his invention perfectly but this will not protect it unless he covers it in the claims. It is in the preparation of the claims that great care and skill must be exercised if the patent is to have any protective value.

INTERFERENCES.

"An interference is a proceeding instituted by the Patent Office for the purpose of determining the question of priority of invention between two or more parties claiming substantially the same patentable invention. The fact that one of the parties has already obtained a patent will not prevent an interference, for, although the Commissioner has no power to cancel a patent, he may grant another patent for the same invention to a person who proves to be the prior inventor."

INFRINGEMENTS.

Infringement consists in the use, sale, or manufacture of something already patented, whereby the patentee suffers injury. Infringement occurs much less frequently than most people suppose, and in general, unless you have special reason to believe that you are infringing another's patent, the best way is not to give yourself trouble about it until some one troubles you.

To determine whether the use of a patent is an infringement on another generally requires a most careful examination of all analogous prior patents.

TRANSFERS OF PATENTS.

Every patent or any interest therein shall be assignable in law by an instrument in writing, and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under the patent to the whole or any specified part of the United States.

Interests in patents may be vested in assigns, in grantees of exclusive sectional rights, in mortgages, and in licenses.

An assignee is a transferee of the whole interest of the original patent or of an undivided part of such whole interest, extending to every portion of the United States. The assignment must be written or printed and duly signed.

A grantee acquires by the grant the exclusive right under the patent, to make and use, and to grant to others the right to make and use, the thing patented within and throughout some specified part of the United States, excluding the patentee therefrom. The grant must be written or printed and be duly signed.

A mortgage must be written or printed and be duly signed.

A licensee takes an interest less than or different from either of the others. A license may be oral, written or printed, and if written or printed must be duly signed.

An assignment, grant or conveyance of a patent will be void as against any subsequent purchaser or

The Open Court

AN ILLUSTRATED MONTHLY MAGAZINE

Devoted to the Science of Religion, The Religion of Science and the Extension of the Religious Parliament Idea.

10 cents per copy - - - - - - $1.00 per year

SCIENCE is slowly but surely transforming the world. Science is knowledge verified; it is Truth proved; and Truth will always conquer in the end. The power of Science is irresistible. Science is the still small voice; it is not profane, it is sacred; it is not human, it is superhuman; Science is a divine revelation.

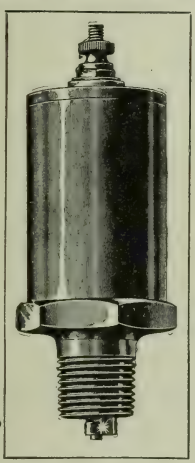
Convinced of the religious significance of Science, *The Open Court* believes that there is a holiness in scientific truth which is not as yet recognized in its full significance either by scientists or religious leaders. The scientific spirit, if it but be a genuine devotion to Truth, contains a remedy for many ills; it leads the way of conservative progress and comes not to destroy but to fulfil.

The Open Court on the one hand is devoted to the *Science of Religion*; it investigates the religious problems in the domain of philosophy, psychology, and history; and on the other hand advocates the *Religion of Science*. It believes that Science can work out a reform within the Churches that will preserve of religion all that is true, and good, and wholesome. Sample copies of *The Open Court* sent on request together with illustrated catalogue of important publications for the Study of Religion. Published by

THE OPEN COURT PUBLISHING COMPANY, 326 Dearborn St., Chicago.

IGNITION PERFECTED

No Induction Coil
No Spark Coil
No Spark Plug
No High Tenison Wire
No Oiling
No Adjustment



Rapid Series of Intense Sparks

Waterproof—Heatproof —Cheapest—Simplest.

Surest results

$7.50 *EXPRESS PREPAID*

Order with remittance and specify thread.

Money refunded if not satisfactory

Ideal for Autos, Boats and Stationary Motors

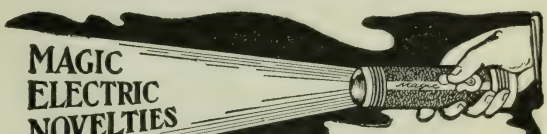
High or Low Speed. Self-Cleaning

THE CLIMAX IGNITOR COMPANY

AMESBURY, MASS.

Write for particulars. Mention "Popular Mechanics."

MAGIC ELECTRIC NOVELTIES



Magic Electric Lights

Illuminate darkest places great distances. Gives 8,000 brilliant lights before renewing dry battery. No wires, no chemicals, no danger, no trouble. Always ready, just touch the button. Carried in the pocket or placed in a keg of GUNPOWDER without danger. Useful to everyone. THE MOST SERVICEABLE LIGHT EVER INVENTED. PRICES, $1.50 to $5.

ELECTRIC BARGAINS

Battery Fan Outfit	$ 7.85
Telephone, complete	$2.50 & 5.95
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	$1.00 to 6.50
Battery Motors	75c to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Porch Lamps	3.00
Electric Carriage Lamps	5.00
Water Motor and Dynamos	10.00
Miniature Electric Railways	3.25
Electric Scarf Pins	1.50

Our new Free Catalogue describes OVER 100 other novel and useful electrical articles. SEND FOR IT TO-DAY. All goods guaranteed. We promptly refund money if dissatisfied.

AGENTS WANTED—YOU CAN MAKE BIG MONEY

selling our goods. They are VERY RAPID SELLERS. No experience is necessary. We show you how. Exclusive territory given. Don't wait. WRITE TO-DAY for NEW CATALOG and FREE particulars.

J. W. SCRIBNER & CO.,

161 Niagara St., Tonawanda, N. Y.

COOLEY COLT CALF AND COW WEANER

The Only Successful Weaner in the World

Guaranteed Not to Make the Nose Sore

Guaranteed to keep any cow from milking herself, no matter how much she has been spoiled by other means, or whether she lies down or stands up.

No. 0 for Calf or Colt 1 day to 4 months old, with Halters, complete	35c
No. 1 for Small Calf or Colt 1 day to 12 months old, with Halters, complete	50c
No. 2 for 2-year-old or Jersey Cow, with Halters	65c
No. 3 for big Cow or Horse, with Halters	75c

The two small sizes are the best and handiest dog muzzles. Sent express prepaid on receipt of price.

Position while eating

Position while trying to suck

COOLEY & RANDEGGER MFG. CO.

103 South Canal St. CHICAGO, U. S. A.

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,

127 NASSAU ST. ROCKFORD, ILL., U. S. A.

Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE

W. L. STEBBINGS

Civil and Consulting Engineer

LICENSED ARCHITECT

Monadnock Block, - - - - Chicago

Tel. Harrison 1104 Cable Address "Stebbings" Directory Cod[e]

FOR GRIMY HANDS

"Miles Ahead of Soap"
HARMLESS-Antiseptic

GRE-SOLVENT

The Utility Co., Dept. C.
231-35 Greenwich St. N. Y. City

For Mailing Lists, Addressing, Imitation Letters and all Circular Work, address

TRADE CIRCULAR ADDRESSING CO.

125 Clark Street, Chicago

Ask for 50 page Catalogue of Lists.

AGENTS WANTED

to canvas Farmers' Telephone Lines for a newly patented specialty. Sells on sight

J. S. MAURER, · Monadnock Bldg., · CHICAGO

WANTED

STRONG YOUNG MEN for FIREMEN and BRAKEMEN on all railroads. Firemen average $65 monthly, become engineers and average $125. Brakemen average $60, become conductors and average $165. Name position preferred. Send Stamp for particulars.

RAILWAY ASSOCIATION, BOX 177, STATION B, BROOKLYN, N. Y.

Work for Yourself
Not Others

Ambitious men and women, there is plenty money in the mail-order business, and it requires but little capital. Get started properly, conduct it right—it means independence and a large steady income. We teach this business completely. Send for free booklet.

Louis Guenther's Mail Order Business, Schiller Building, Chicago

mortgagee for a valuable consideration without notice, unless recorded in the Patent Office within three months from the date thereof.

No instrument will be recorded which does not in the judgment of the Commissioner, amount to an assignment, grant, mortgage, lien, incumbrance, or license, or which does not affect the title of the patent or invention to which it relates. Such instrument should identify the patent by date and number; or, if the invention be unpatented, the name of the inventor, the serial number, and date of the application should be stated.

Assignments which are made conditional on the performance of certain stipulations, as the payment of money, if recorded in the office, are regarded as absolute assignments, until canceled with the written consent of both parties, or by the decree of a competent court.

In every case where it is desired that the patent shall issue to an assignee, the assignment must be recorded in the Patent Office at a date not later than the day on which the final fee is paid.

Patents may be granted and issued or reissued to the assignee of the inventor or discoverer; but the assignment must first be entered of record in the Patent Office. And in all cases of an application by an assignee for the issue of a patent, the application shall be made and the specification sworn to by the inventor or discoverer; and in all cases of an application for a re-issue of any patent, the application must be made and the corrected specifications signed by the inventor or discoverer, if he is living.

(Continued next month.)

TROLLEY MILK CARS.

In Brooklyn, hereafter, the cans of milk of the Borden Condensed Milk Company will be handled by the new trolley freight line. Formerly the milk was brought over from New Jersey by heavy double-team trucks, crossing by ferry to New York, thence across the city and into Brooklyn by way of the bridge, returning at night for another morning's load. Now the cars carrying milk cans will be floated from Jersey City to South Seventh street, Brooklyn, and transferred to the cars of the Brooklyn Rapid Transit Company and by them carried to the distributing stations.

THE SAILORS OF THE RAIL.

Up and down the iron ladder,
Running o'er the decks of cars,
While the wheels seem growing madder
As they rush beneath the stars,—
Ride the Sailors of the Rail,
In the calm or in the gale.

Out across the morning meadows,
Fragrant with the new-mown hay,
Or where rest the deepest shadows
Of the night, where dangers play,
That oft cause their cheeks to pale,—
Ride these Sailors of the Rail.

Great and strong is their true friendship.
Brothers, comrades, every one;
Happy greetings from their kind lip
Meet the lads, as from the run
They come home with some new tale
Of these Sailors of the Rail.

What their thoughts are when they sever
Suddenly Life's cord, and go
From this earthly "Run" forever,
No one else will ever know;
For alone they pass the Veil,
Silent Sailors of the Rail.

—Railroad Trainmen's Journal.

CONSUMPTION

CURED

By Dr. John Warren Walker's

ANTISEPTIC OIL AND BALSAM TABLETS

HOW THEY CURE:

By arresting the action of the tuberculous germs and driving them from the system—stopping the cough, fever, night-sweats and expectoration—increasing the appetite, nutrition, weight and vitality—soothing and healing the affected organs.

The tablets are pleasant and agreeable to take, and will give aid and encouragement to the most delicate stomach. Their action is rapid, regular, grateful, and one day's use will prove their good effect. Put up in jars of 700 tablets—an amount sufficient for six weeks' treatment at $5.00 a jar.

BANK GUARANTEE

In order that you may be *Sure* you are not sending me $5.00 for a remedy of doubtful value, and to prove by *practical test* that my tablets will do *all* and a *great deal more* than I have stated above, I will protect you fully in the following manner:

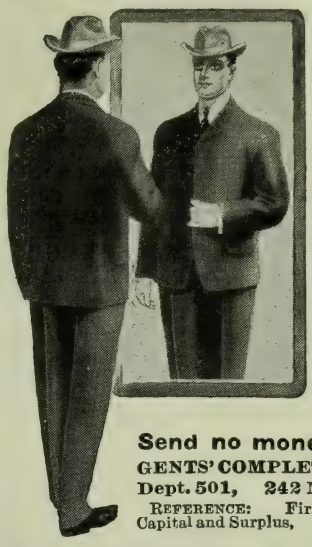
With each jar I will send you my check for $5.00 payable to your order. At the end of ten days if you find the tablets have not done you the good I have led you to expect by the statements above you can return what remains to me and cash the check.

When you write describe your condition so that I can give you the necessary advice.

Dr. John Warren Walker, 1 So. Hoyne Ave., Chicago, Ill.

$8.00 OUTFIT FREE

A Dunlap block, Derby or Fedora Hat	$2.50
A pair of stylish Lace Shoes, the new queen last	2.50
A Percale Shirt, detachable Collar and Cuffs	1.25
A neat Silk Four-in-hand Necktie or Bow	.50
A pair of fancy Web Elastic Suspenders	.50
A Japanese Silk Handkerchief	.50
A pair of fancy Lisle Thread Socks	.25
Thousands of American citizens Pay Cash for this.	$8.00



To introduce our famous made to measure custom tailoring we make this unequaled offer of a **GENUINE CHEVIOT Suit made to your measure** in the latest English Sack Style, well made and durably trimmed, for only **$10.** *Equal to your local tailor's $20 suit* and give you all the above complete outfit **FREE.** Send us your name and address and we will send you

Free Samples

of cloth, measurement blank and tapeline for size of Suit, Hat, Shoes and Shirt.

Send no money, but write today to

GENTS' COMPLETE OUTFITTING CO.

Dept. 501, 242 Market St., Chicago

REFERENCE: First National Bank, Chicago; Capital and Surplus, ... $12,000,000

The mechanical principles that have been proven best in all typewriters find concrete expression in the Standard

CHICAGO TYPEWRITER

$35.00

This almost human piece of mechanism exceeds the capacity of the most skilled fingers

CHICAGO WRITING MACHINE CO.

76 WENDELL STREET, - CHICAGO

RHEUMATISM

CURED THROUGH THE FEET

Poisons Drawn from the Blood through the Large Foot Pores by New Discovery. TRY IT FREE.

We want the names of 100,000 rheumatics. Write us today. We will send you by return mail a pair of the celebrated Magic Foot Drafts, the great new cure for Rheumatism, chronic or acute, Muscular, Sciatic, Lumbago, Gout, etc., no matter where located or how severe. We send them prepaid and you take them home and try them before you pay us one cent. Then, if you are fully satisfied with the benefit received, send us One Dollar. If not, you pay nothing whatever. You can see that we couldn't afford to send out these Drafts on approval if they didn't cure, for no one pays until he is satisfied.

Cut showing network of veins in foot.

Magic Foot Drafts are worn inside the stocking without inconvenience and cure by drawing out and absorbing the uric acid from the blood, which is most easily reached through the large foot pores. The Drafts are curing hundreds of cases considered incurable. They are harmless—A safe, common-sense remedy. Costs nothing to try, and if cured, one dollar is little to pay. Booklet of remarkable testimonials free with the Drafts. Send no money—only your name. Write to-day to the Magic Foot Draft Company, 651 Oliver Building, Jackson, Mich.

The World's Headquarters for

ELECTRIC NOVELTIES AND SUPPLIES

If It's Electric We Have It.——We Undersell All.

Battery Table Lamp	$ 3.00
Battery Hanging Lamp	10.00
Telephone, complete, $2.50,	5.95
Electric Door Bells	1.00
Electric Carriage Lamps	5.00
Hylo Turn-Down Lamps	.60
$8 Medical Batteries	3.95
$12 Belt, with Suspensary	2.50
Telegraph Outfits	2.25
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights	3.00
Electric Railway	2.75
Pocket Flash Lights	1.50
Necktie Lights 75 cents to	3.00

SEND FOR FREE BOOK

$3 Electric Hand Lantern **Agents Wanted**

OHIO ELECTRIC WORKS . . . Cleveland, Ohio

Electric Novelty Bargains

Catalogue for Asking.

ELECTRIC NOVELTY CO., 16 E. Market Street, Indianapolis, Ind.

Learners Telegraph Set,	$1.75
Vest Pocket Light,	1.50
Electric Bicycle Lamp,	3.50
Electric Scarf Pin,	1.00
Ivory Elk Head or Skull Pin,	2.50
Electric Gas Lighter,	1.50
Electric Door Bell Outfit,	1.00
Battery Motors,	1.00
Complete Medical Battery,	2.00

SEND FOR

POPULAR MECHANICS NEW PREMIUM LIST

THE GREAT AMERICAN T. E. A. COMPANY

We are selling the BEST NEW CROP

50c TEAS

in the U. S.

Oolong, Eng. Breakfast, Gunpowder, Souchong, Congou, Mixed, Japan, Young Hyson, Imperial, Ceylon.

Good Oolongs, Mixed and Eng. Breakfast, 25 & 30c a lb.

We are selling the BEST

25c COFFEE

Good Roasted COFFEES, 12, 15, 18 and 20c a lb.

SPECIAL OFFER

ON a SAMPLE ORDER of $5.00 and upwards, of Teas, Coffees, Spices, Extracts and Baking Powder, we will allow you **20 per cent off and pay all express charges**, so that you may thoroughly test the quality of the goods. This is a chance that is seldom offered; it gives all a chance to purchase our goods at **less than cost.**

For full particulars and prompt attention, address

Mr. CARL, Care of

The Great American Tea Company,

31 & 33 Vesey St., P. O. Box 289, New York

THE JAPANESE YEN.

When the public reads that 100,000,000 yen has provisionally been set apart by Japan for war purposes, it may perhaps put an exaggerated estimate on that amount. Although Japan has a gold standard, the yen is of silver currency, and fluctuates with the price of silver, so that at the moment 100,000,000 of them means scarcely more than $50,000,000. But even this is an immense amount in a country in which the wages of a skilful artisan are often not more than 3 yen a week. The Japanese currency system is decimal. Thus the yen, or dollar, is divided into 100 sen, or cents; the sen into 10 rin, the rin into 10 mo, the mo into 10 shu, and the shu, finally, into 10 kotsu. Government accounts do not take note of any value smaller than a rin, but estimates by private tradesmen often descend to mo and shu, which are incredibly minute fractions of a farthing. No coin exists, however, to represent these liliputian sums.

A FLAT WHEEL.

"That's a pretty noisy passenger you've got in there," remarked the man who was smoking on the front platform. "Is he crazy, or only drunk?" "Neither one," said the motorman. "He's just got a flat wheel in his head."

SUMMER THE BEST TIME FOR STUDY

People used to think that fall and winter was the only time to study and that there was little use in even thinking about such things at any other time. But experience has proven otherwise; not only that, but it has developed a most surprising and interesting fact. People who study in summer, as a rule, learn more than they would in winter.

The explanation of this is self-evident. It does require more will power to sit down and work out problems and commit to memory during a pleasant summer evening than if a blizzard were raging outside, but the very fact that some additional force is needed, seems to emphasize the effort. An engineer makes a run at high speed for a hill and goes over the top faster than otherwise; you break a bone and, ordinarily, nature will mend it stronger than before. So the person who has the bound-to-rise spirit in him determines to do some summer study and, in overcoming a natural inclination not to study, exerts so much will power that the result is a stronger concentration on the work than usual; and in the end the subject is more thoroughly comprehended. In evidence of this, statistics of the International Correspondence School (we quote from this school simply because it is the oldest and largest, and everywhere known to do good work) show most surprising and gratifying figures. While the number of students is far less during June, July and August, than at any other time of the year, the examination papers and positions afterward taken by their students show that it is the young men with the ginger to buckle down to study in the good old summer time, who are the boys that eventually get there and do things.

We are all working to accomplish certain ambitions; some one thing, some another; and in almost every instance the usual time in which these can be attained may be greatly shortened by stirring ourselves, putting on steam and getting busy.

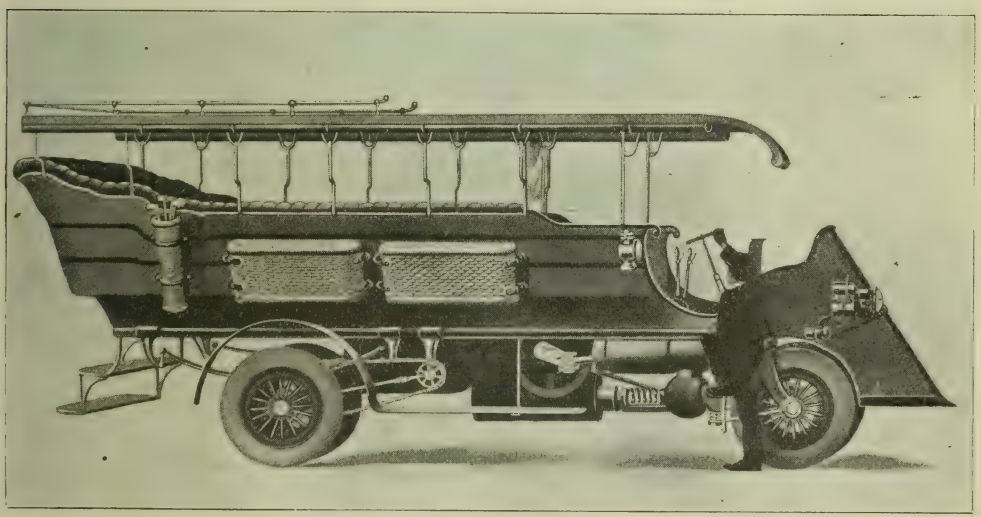
Young man, when the fall comes you will feel mightily pleased with the summer's work which has made you even fairly proficient in some branch of electricity, or any one of the several hundred courses now so successfully taught by mail; and you will take new courage for still greater progress from the increased pay which increased ability secures.

Popular Mechanics

Vol. 6. No. 7. CHICAGO, JULY, 1904. 10 Cents a copy. $1.00 a year.

Largest Automobile in the World

Has 400 Horsepower -- Is Expected To Run 100 Miles An Hour -- Cost $35,000.



The Touring Body.

The largest automobile in the world, costing $35,000, of 408 horsepower, and capable of a speed of 100 miles, has lately been built at Cleveland, Ohio.

This machine, which was built for Louis D. Schoenburg, will accommodate ten persons with separate sleeping apartments for long distance trips, besides which they may have their meals served in the vehicle, as it is provided with a kitchen and dining-room. It also carries a dynamo for electric lighting and heating. Besides being so commodious the interior appointments and decorations are rich, beautiful and luxurious.

The car has three bodies: The Pullman body described, a touring body and a racing body. It certainly surpasses anything yet attempted in automobile construction and will probably stimulate a number of competitive efforts.

Demonstration of World's Navies in 1900.

Is This Remarkable Assemblage of Fighting Forces to Be Repeated?

The Fighting Fleets of the World Assembled in China Waters in 1900

The navies of the world lay for months off the coast of China during the Boxer troubles in the summer of 1900. Side by side were the battleships of Russia and Japan, and in that remarkable cosmopolitan fleet were battleships and cruisers of the United States, Germany, France, England and Austria. The great world powers were there to enforce peace in China, and by their irresistible strength awe into submission the nation which has always received foreigners under protest.

The combined fleet numbered nearly 100 fighting ships. Owing to the shallow waters of the bay they anchored out 17 miles from shore off Taku, China. The Brooklyn, which arrived in July, was among the first to anchor and remained until October, when peace was restored and the fleet sailed away.

Is this remarkable assemblage to be repeated? Will the nations of the earth be drawn into the controversy? China is already being infected with the war fever. France has promised to aid Russia if China rises to assist Japan. If France helps Russia, then England will come to the assistance of the Japs, and when once the spark has touched the powder train none can tell where the explosion will reach.

The illustration is from a rare photograph in the possession of Geo. W. Richardson, of Chicago, who was chief electrician on the Brooklyn during the allied demonstration. The original picture was worked on silk by a Japanese artist who was on one of his country's ships.

There are thousands of unemployed workmen in New South Wales. Laboring conditions have been grossly misrepresented and many immigrants from the United States are the victims. The law gives the unions a monopoly of the work at fixed prices.

Within six months the law making Sunday a day of rest in Spain will go into effect. The only exceptions will be in cases where work is an absolute necessity and persons under 18 years of age and all women are not to be employed at all on that day.

Huge Floating Dock Takes 8,600-Mile Voyage

Constructed in an English Yard and Is Towed to South Africa --An Eventful Trip

By A. Leach Woods, Durban, Natal, South Africa

After towing it a distance of 8,650 miles over stormy seas, the English government has at last succeeded in anchoring a huge unwieldly floating dock safely in the harbor at Port Natal, South Africa. The feat is one of the greatest of its kind ever accomplished.

In charge of two sturdy tugs, the huge structure, 475 feet in length, 96 feet 2 inches wide and with a lifting power of 8,500 tons, day by day, surely, safely, made the trip across the thousands of miles of ocean expanse, and in conveying her, 24,000 tons of coal were consumed, 18,000 tons of this enormous quantity being bunkered on the dock itself and 600 tons being carried by the tugs, which renewed their supply at various points.

The great increase in importation at the Natalian port caused the colonial government to obtain a thoroughly up-to-date floating dock, with workshop, and one that would in every way be capable of meeting any calls that might be made upon it and the requirements of the port generally. An order was therefore placed in September, 1901, with the firm of Messrs. Swan, Hunter & Wigham-Richardson, Ltd., of England. This dock eventually left England in tow of the S. S. "Baralong" of the Bucknall line of steamers, but after a successful voyage and when only about 720 miles from her destination, during a strong wind, she broke away from her escort and went ashore off Mossell Bay before anything could be done to save her. Several unsuccessful attempts were made to re-float her and ultimately she was abandoned. The unfortunate

The Floating Workshop on Board the Dock

Watching the Towing of the Dock Into the Harbor

loss of this dock, necessitated ordering a second, which was launched at Wallsend-on-Tyne on August 8, 1903, from the yard of the builders of the former one. This dock at the order of the government was made some 100 feet longer and of about 4,000 tons greater capacity than the original one, and in the comparatively short space of six months the English firm of builders completed the great engineering work.

The launching ceremony was performed by Mrs. Tatham, the wife of Mr. F. S. Tatham, K. C., M. L. A., of Pietermaritzburg, Natal, on August 8, 1903, the dock being christened "Sir Walter" after the Agent General for Natal, Sir Walter Peace. The dock, after undergoing a few trials on the Tyne, left for Port Natal, on September 16, 1903, and arrived safely on the 8th of February, 1904; after a voyage of over 8,000 miles. No small credit is due to the captains of the two Dutch tugs which successfully towed this huge structure over so many miles of sea. The captain in charge of the dock was Captain Verschoor; the tug "Zwartezee" (542 tons gross) had as its skipper Captain Post, and Captain Koenes was responsible for the "Oceaan" (387 tons gross). With the recollection of the fate of the previous dock, it is not to be wondered at that the progress of this one, across the thousands of miles of ocean, was watched most anxiously by all Natalians. It was, however, not without incident that this huge structure reached its destination, the most southerly port of South Africa.

After leaving the Tyne, a good wind prevailed until Portland was passed and then the rough weather which was experienced after crossing the "line" snapped the towing hawsers, causing her to drift a considerable number of miles out of her course and at the same time placing her in danger of foundering. Fine weather was the order from the island of Maderia to St. Thomas where the tugs called for coal. From that spot to Walfisch Bay the atmospherical conditions continued to be all that could be desired. On December 22nd, however, terribly rough weather was encountered. The towing rope of the "Zwartezee" broke, catching on the propellor and the sister tug was left single-handed to hold the bulky craft until her helpmeet could obtain connection again. This, however, proved too much for the "Oceaan," which was ultimately obliged to let go of her charge. Consequently the dock began to drift and 24 hours elapsed before the tugs had finished chasing the dock and become again attached to the runaway; it was then ascertained that the massive structure had drifted a distance of 80 miles! The captain of the dock, however, was not seriously alarmed at the state of affairs, knowing that the tide would carry them away from the shore. The weather from the date of this exciting adventure—an adventure which the captains stated very materially helped to relieve the monotony of the voyage—to Capetown, caused no anxiety. At that port they called for coal and provisions, remaining a fortnight for this purpose. The worst part of the whole voyage was from this latter port to Durban, for not only was the weather bad, but the current was against them the whole way. The distance is 818 miles and it took 17 days to cover this remaining portion of the voyage. The actual distance sailed was 8,650 miles—that is, including the distance covered when the dock broke away and drifted.

Perfectly equipped for her work, the dock,

The Dutch Tug "Zwartezee" in the Harbor, Port Natal

which is 70 feet between the guard timbers on the side walls, can accommodate vessels up to 68 feet beam, and, while still retaining a freeboard of 4 feet 3 inches, can take a vessel drawing 23 feet over keel blocks 4 feet high. The dock proper consists of three pontoons and two side walls, to which the pontoons are connected by means of movable joints, so that any of the pontoons when required can be removed and lifted by the dock itself, thus making it self-docking in all its parts. The machinery is contained in the upper portion of the walls and consists of two separate but

The Floating Dock Entering the Harbor, Port Natal--Passing the Lighthouse

indentical installations. Each installation comprises two boilers and two pumps, each pump being driven by its own engine, and the piping of the dock is so arranged that either pump can empty the whole of the compartments on its side of the dock. Besides this there is communication through the central bulkhead across the dock so that in case of a breakdown it would still be possible to lift the dock by the engines of one side alone. The boilers are of the ordinary return tube marine type, 10 feet long by 8 feet 6 inches diameter. The engines are of the horizontal compound type, placed on their sides and connected directly to the vertical spindle of the centrifugal pumps, which are placed at the bottom of the dock, directly on top of the main drain of the pumping system, the weight of shafts and pump impellers being taken on ball bearings at the engine deck. The dock itself is divided into 44 watertight compartments, each of which has a separate pipe leading into it, each pipe being provided with its separate valve. All these distributing pipes are collected into the main drain, on which the pumps are seated, and the discharge and inlet into this main drain are governed by large screw-down valves, and by automatic flap valves outside the dock. The different compartments are all worked by means of bell cranks and rods and levers from the valve house placed centrally on each wall, so that the valve man has complete control over the whole of his section of the dock. As regards fittings, the dock has 46 sliding bilge blocks, which can be hauled in under the vessel by means of chains from the top deck. It is further provided with four mechanical side shoes by means of which a vessel can be centered on the dock. Four steam warping winches, two on each wall, are provided for hauling the vessel into the dock.

In addition to all the ordinary requirements of a dock, the present one is provided with a very complete electric installation which will enable work to be carried

out on ships through all the hours of both day and night. This installation which is situated in one of the walls is of a marine type boiler and two steam dynamos, duplicates of each other, and by means of a flexible cable the current is conveyed across the dock to the other wall where it is connected to a switchboard from which the different services emanate.

The lighting installation consists of three circuits: first, there are the standard 200 candlepower lamps along the top of the walls, these light the dock generally; secondly, there are a series of clusters of lamps in reflectors, which can be carried to any part of the dock or ship on dock, where

To fully appreciate the dimensions of the dock it is necessary to go on board. Upon entering the structure the first idea is which way to turn. Tiers of ladders lead from the dock's bed to the upper bulwarks and are bewildering to the uninitiated; however, when the uppermost level is reached, on either side are found compartments for the crew, engine and machine regulators, steam winches and with the necessary lifeboats fully equipped.

But, perhaps, the most important and interesting feature of the equipment is the floating workshop which was brought out on the dock and has been constructed to meet the requirements of steamers and

Entrance to the Harbor, Port Natal--View From the Lighthouse

light may be required; and, lastly, there are the ordinary incandescent lamps in the boiler, engine and store rooms and other compartments of the dock. The electrical installation is of sufficient power to enable electric drills to be taken off from the plug boxes for carrying on work on the hulls of ships for which purpose it is possible to utilise both the steam dynamos simultaneously. The system used is the direct current, 110 volts, the electric cables being all contained in steel tubes, with the exception of the cable crossing the dock and which is drawn into lead and suitably armoured, thus showing how carefully every detail of this huge floating structure has been considered.

other vessels needing repairs. Being self-propelling it can, if desired, steam straight to the vessel with rapidity, and without delay. In length she is 129 feet 3 inches, and her width inside the rubbing fenders is 40 feet. She has two screws, each of which is driven by a compound surface condensing engine, with cylinders 12 inches and 26 inches by 15-inch stroke; and her mean speed, on trial, was 7.12 knots. A marine type boiler supplies the steam at 130 pounds pressure. In spite of her bluff shape the vessel is very handy and steers remarkably well. The rubbing fenders permit her to approach other crafts without doing them harm by contact.

On the deck the workshop is erected. It

contains the following machine tools and appliances: A screw cutting gap lathe, 10-inch centers and 15-foot bed admitting 9 feet 6 inches between the centers and 3 feet 4 inches by 12 inches in the gap; a shaping machine, having a maximum stroke of 18 inches, and a table 6 feet long; a double-geared drilling and tapping machine and a 5-foot radial drilling machine. A 300-pound steam hammer, on a special foundation, has also been supplied and a punching and shearing machine. The machine will push 1-inch holes in 1-inch steel plates and shear plates of the same thickness, angles, etc. There are also two fixed smith's fires and a portable one and a slab

storage and another hatch gives access to the machine shop. The latter is well lighted by swing windows and there is a large opening covered by an awning in the roof. As at times it will be necessary to keep a staff of men on board, accommodation has been provided for six Europeans and 10 natives. There are six sleeping bunks on each side of the vessel, and the necessary galleys, stores, etc. Thirty-eight tons of coal can be carried in the bunkers on either side of the boilers, and the fresh water tanks hold from 18 to 20 tons.

The floating workshop which has created as much interest as the dock itself promises to justify its existence at the port. A week

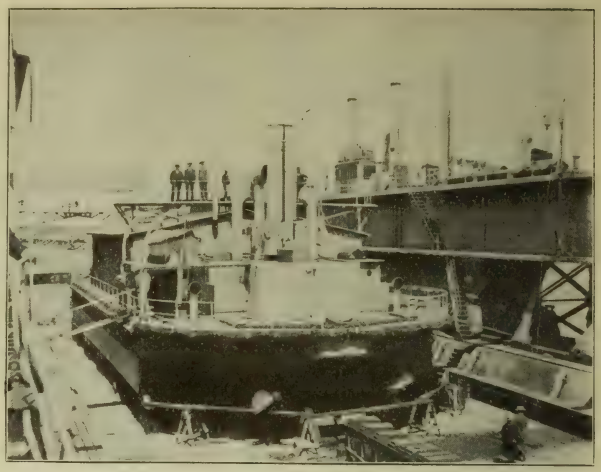
The Floating Dock Crossing the Bar at Entrance of the Harbor--Two Dutch Tugs (White Rings Around Funnels), Assisted by the Government Tug "Sir John," Towing the Dock In

for levelling. A 3-inch pipe screwing machine is also found on this commodious workshop. The tools are driven electrically by motors and a reserve of 10 horsepower has been provided for driving any tools that may be added at any future time. The vessel is lighted electrically from the same generating plant. There are six motors, one to each machine, only the blast fan and the grindstone being belt-driven. Situated at the forward end of the craft is a 40-ton cantilever crane, with a span of 40 feet. Besides its special use in repair work, it should prove invaluable for many jobs in the harbour or even outside. Behind the crane is a hatch leading into the hold of the vessel, which affords ample space for

after the arrival of the dock, the workshop was successfully floated off, the dock being partly submerged for the purpose and its off-spring now lies close by awaiting its first call to duty.

The seaport of Natal is Durban, and, excluding Delagoa Bay, which is not in British territory, it has one of the finest harbors in South Africa. Its population is about 60,000 and like most colonial towns it is of large dimensions, its area being 10 square miles. Natal is essentially an Englishman's colony and to the energy, confidence and enterprise which this fact implies, may doubtless be accredited the remarkable trade progress which it has made. Ten years ago the imports of

merchandise into Natal were valued at more than two and a quarter millions sterling annually. Last year, however, the value of the imports entering Natal amounted to $75,327,270, or nearly a sevenfold increase during the decennium. During the first half of the decennium the imports were at the rate of $21,533,500 per annum; during the second half they were $49,629,500, or considerably more than double. The total for the year, compared with 1902, showed an advance of $8,740,045. As much as 98 per cent of the total represented goods from oversea, being the extent to which America, Europe, Australia and a few Asiatic countries are benefited by Natal, either as an actual consumer or as as intermediary for inland colonies. Natal's trade budget is such that the colony may well be proud of it and the fact that the rapid progress which the country is making will tend to make these results in future years seem small, adds rather than detracts from its significance.



Near View of Floating Workshop in Position on the Dock as it was Brought Out

Already there are several ships waiting to make use of the new dock, and as soon as it is handed over, there is every likelihood of a continual demand for its services.

Motor Bus to Compete With Street Cars

Pittsburg to Have a Trackless Tramway Service

Pittsburg is to have a new auto passenger and freight service, which will start up with 40 vehicles operating 35 miles of lines. Pittsburg's bad street car service gives the company a good field and the people are quick to avail themselves of the opportunity to ride long distances for five cents.

The Liberty lines in the Squirrel and Morningside districts, the People's lines, East Liberty and downtown will be the first to be operated, with 15 passenger vehicles and 25 express vehicles, the latter to give hourly service if need be. Later on the freight service will be provided for.

The company plans to give four kinds of service; all transfers being free. The American, 5-cent fare, number of passengers not limited; the European, a fare and a half with a seat guaranteed; the school and works plan providing for special service at special rates for morning and evening hours only; and the club plan giving exclusive service at certain hours for any company of persons.

It is said that Pittsburg street car lines are completely in the hands of politicians and the service is as bad as any in the country. The Auto Traffic Company will operate entirely independent of these influences, which will enable them to give the long distance rate.

NEW TRIUMPH FOR THE PHONOGRAPH.

A large audience at Fort Harrison listened to a band concert given over the telephone line by a phonograph and thought they were getting the real article. The concert had been arranged for to be given by the Brewery Band at Butte, Mont., but when the time came the telephone line would not work. The manager of the telephone company settled the matter by moving his phonograph up to the telephone and the Fort Harrison audience enjoyed the evening without a suspicion.

Napkins are provided in Vienna telephone booths for wiping off the mouthpiece of the transmitters. The napkins are inscribed, "Wipe, if you please," and are changed frequently.

AUTOMOBILE TOUR TO ST. LOUIS.

Automobilists everywhere will join in the grand tour to St. Louis the coming summer, which is being organized by the American Automobile Association. The arrangements for the tour are very simple. The prospective member fills out an entry blank, giving the starting point and destination, also the usual data about his car and party and pays an entry fee of $10,, which secures to him route books, and a number plate for his car. The association arranges for accommodations for garages at all stopping points so that no forethought need be given the matter. Each entrant must purchase his supplies, gasoline and oil, etc., at these places. There will be but two stops where cars cannot be stored indoors.

At each night's stop on all the divisions of the route registration books will be open until 10 o'clock at night, and those registering in time at every stop along any route will receive a certificate on arrival at St. Louis to the distance traveled and as to the running regularity of the car.

From New York there will be two main routes, one by way of Philadelphia, Pittsburg, Wheeling, Columbus, Richmond, Indianapolis, St. Louis; the other by way of Albany, Syracuse, Rochester, Buffalo, Cleveland, Toledo, Chicago, Pontiac and St. Louis. Routes from Baltimore, Philadelphia, Boston and many minor cities join these routes at various points.

Anyone wishing to procure entry blanks for the tour should apply to the touring committee of the A. A. A., 753 Fifth avenue, New York.

STREET CARS USED AS WINTER QUARTERS FOR CONSUMPTIVES.

Rhode Island's first open-air camp for consumptives has settled the question of winter quarters very satisfactorily. The Pine Ridge Camp, at Foster, R. I., opened in June, 1903, and during that summer the consumptives lived in 4-walled tents, keeping the sides rolled up except during violent rain storms. The tents cost about $15 each. An old barn was used as a dining room and a woodshed as a kitchen, and from 25 to 35 patients were under treatment constantly.

But when winter approached not enough funds were on hand to erect cabins. Persons who had lost a friend or near relative by phthisis were asked to donate money to build a cabin in memoriam. Ten cabins at $150 each were erected by this means, each

Cabin for Consumptives

cabin of yellow pine, 10 by 12 feet and surrounderd by a 4-foot piazza. Provisions were made for much light and good ventilation and a sign bearing the name of the donor was placed over each door. Two patients lived in a cabin. In severe weather

Old Street Cars as Living Quarters for Consumptives

the cabins were heated by small coal stoves.

Then the idea of using old street cars for the purpose came up. Some were donated and others were purchased at from $5 to $15 each. These were removed from their trucks, raised 18 inches from the ground, refloored and furnished for one patient, and were found to be perfectly adapted to this use, the amount of window space, the means of ventilation and the low cost all being great advantages.

Victoria Falls, with its 35,000,000 horsepower, is to be utilized for supplying electric power to a large portion of Africa. It is proposed to fix steel tubes eight feet in diameter across the edge of the abyss which makes the fall. What water forces itself through these tubes will drive a turbine and generator supplying 5,000 horsepower.

TELEPHONES AT STREET CORNERS.

Telephones at street corners, either on the telephone pole, or on the same post with the U. S. mail box, may be a future convenience of many cities and towns. Already they are in use to a limited extent, keyless stations opened by merely turning the handle, and which contain the pay station and

Street Corner Telephone at Bridgeport, Conn., on Same Post as the U. S. Mail Box.

a directory, being the equipment. Hollow iron posts allow the necessary ground wires. In some places the agreement with the company insures that, for the privilege of placing the telephones, all emergency calls, such as police, fire departments and hospitals, may be free of charge. This makes the system a public benefaction, saving time in case of fire or accident, and to an extent protecting the citizen. These stations are paying investments to telephone companies, as they require little extra wiring and cost little to maintain.

Street Telephone on Telephone Pole.--Directory and Pay Station Inside of Box.

George A. Long, in The American Telephone Journal, says there is no reason why these stations should not supersede the so-called police telephone systems now in use. Police could send in their reports to headquarters over the public stations and the blue police box would no longer be needed.

Certain it is that such a system in residential sections of cities would be of great public benefit, as it would in parks and along boulevards and roads frequented by pleasure-seekers. How often the automobilist would find it of use! How often it would save some person's going four or five blocks to the drug store or grocery!

JAPANESE IMITATE FOREIGN MACHINES.

The imitative power of the Japanese exemplifies itself in the extraordinary facility with which he counterfeits foreign trade marks and trade goods. "It would not be amiss," says a consular report, "if commercial travelers were empowered to register in Japan the trade marks of the manufacturers for whom they travel. One or two cases have come under notice where a traveler on his arrival found that the articles he represented were being freely and cleverly imitated to the great loss of employers."

Not only do the Japanese reproduce the machine of foreign manufacture with minute exactness, but they place thereon the foreign trade mark exactly as it appears on the machine.

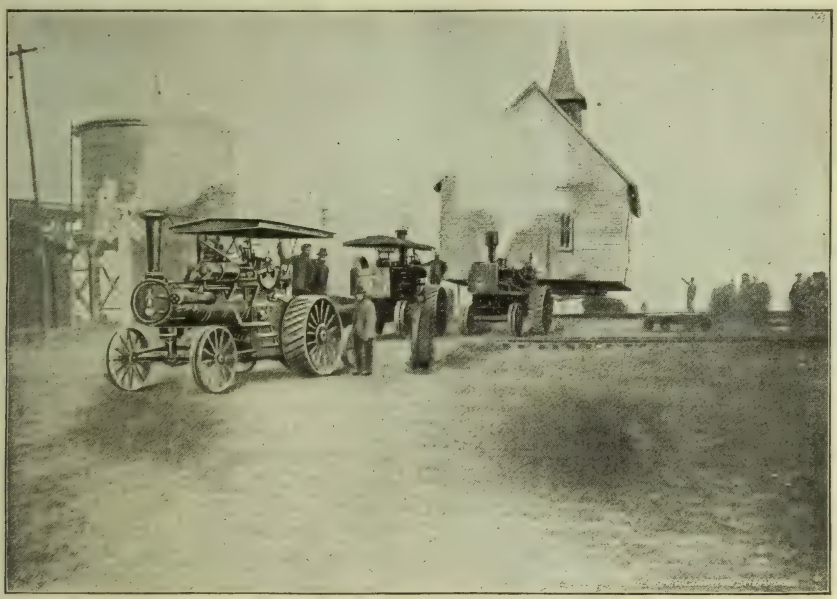
OKLAHOMA PERFORATED WITH DEEP WELLS.

Boring for water and minerals in Oklahoma has resulted in perforating the entire state with numerous wells of enormous depths. Prof. Charles A. Long of the University of Oklahoma says: "In almost every county in Oklahoma wells of more than 200 feet have been drilled. A few have been put down for prospective purposes; more, however, were drilled in search of water. In general, no water of any practical value is found below a depth of 400 feet. As a rule, water below this depth is salt. Near the base of the Redbeds, sandstones are found. Above the sandstones there is a large mass of clays and shales, then the horizon of the gypsum ledges comes in and above this is another sandstone member."

KANSAS CHURCH MOVED LONG DISTANCE.

The many moving feats accomplished lately, fully demonstrate the advance made in this line of engineering. In fact, did an entire city decide that it preferred some locality other than the one it had always occupied, it would not be impossible for it to migrate.

A Kansas church has just been moved a distance of 42 miles without even breaking a window pane. This church is 26 feet wide, 40 feet long and has a 56-foot steeple, says the American Thresher. The pulpit is



Hauling a Kansas Church 42 Miles Overland

8 by 10 feet and 8 feet high, and the vestibule 8 by 12. It required three engines of 20 horsepower each, three 1,600-pound house-moving trucks, two water wagons, one coal wagon and team, a cook-shack and 10 men, six and one-half days to accomplish the great task. Thirty-five telephone and telegraph wires were taken down and crossed, besides creeks and four railroads.

The church was moved from 23 miles north of Wichita, across Sedgwick county into Summer county. Mr. Bert Hodson, of Wichita, had the contract.

Don't forget to send for Popular Mechanics premium list.

STEEL CARS FOR NEW YORK SUBWAY.

That such catastrophes as the Paris underground railway fires and the Iroquois horror bear results in the form of life-saving devices and better fire protection everywhere is again brought to mind by the new steel cars to be used on the Rapid Transit Subway, New York.

These cars are 51 feet 2 inches long, outside of platform sills, and 8 feet 7 inches high. The present cars are somewhat heavier than wooden cars, but time will probably see a reduction in weight.

In appearance the car much resembles a first class coach. It has vestibules, longitudinal seats at each end and cross seats at the center, its seating capacity being 52. The seats are cane-covered. Very little wood is used in its construction; the inside lining and under panels are of electro-asbestos, and the head lining is of stamped sheet steel. All the mouldings are of copper. The flooring is of corrugated sheet steel covered with a monolith composition, insuring an easy tread. The capacity of its motors is 400 horsepower.

A telephone line running from Grand Central Station, New York, to the La Salle Street Station, Chicago, is the longest ever installed by a transportation company.

Telephone Engineering an Inviting Field for Young Men

How important a subject telephone engineering has become only those know who have watched the growth of a business that will before long have put 100,000,000 people into oral communication with each other. The complex character of all the work that has to do with enabling people in Missouri to call up those in Ohio or Pennsylvania has made a thorough preliminary training the first necessity to the young man who enters any of the various departments of telephony. At the Massachusetts Institute of Technology, for example, there were two graduates in electrical engineering in 1884, while today there are some 200 young men studying this one general subject and among them at least one in every six is especially interested in the telephonic courses. Yet these students, of course, represent but a small fraction of the number of future telephone engineers now training at the various schools and colleges throughout the country that have followed the institute's example in establishing courses in what is perhaps the most important of the modern "commercial professions."

It is said that already about 50,000,000 inhabitants of the United States have access to a telephone. Not all these are within the possibility of direct connection with each other; the existence of a considerable number of the so-called "independent" companies precludes that. In the course of time, unquestionably a universal system will be established linking together all the centers of population, then with present facilities anybody might count upon being able to call up, or be called up by, any other individual of the fifty millions in the district covered by exchanges.

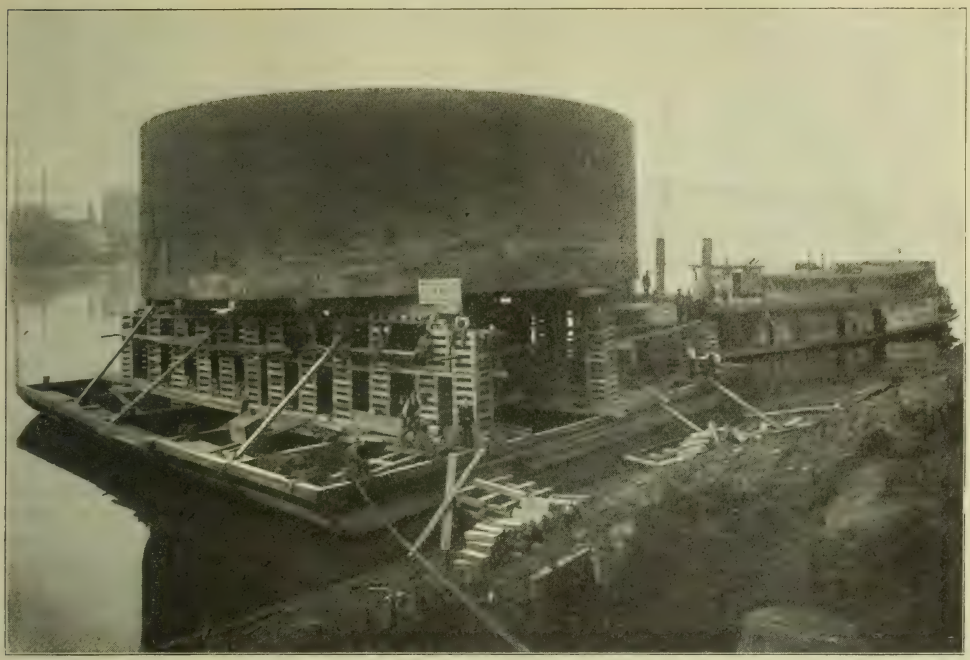
That the business of thus securing to virtually the entire population of the United States the privileges of long distance talking is a big enough one to require all sorts of specialists goes without saying. No profession needs more thorough-going preparation. As a prominent electrician has said, "A good telephone engineer is practically all kinds of an engineer." That is to say, the man who plans to install a telephone service encounters problems that belong to the mechanical engineer, as well as others that embrace about every branch of electrical engineering.

Of course the basis of the telephone engineer's training is such knowledge of the highest mathematics as will enable him to make the endless computations necessary to the production of any plan, whether for a small induction coil or for the wires of a transcontinental system. He must know, for instance, all that is to be known about theoretical electricity, must understand the general phenomena and laws of sound, especially as they relate to speech and hearing; and, naturally, he must be expertly familiar with the details of telephonic communication and with the installation and management of great systems. These things the technical school teaches him in lecture rooms and laboratories, by endless experiments, by observation and finally by actual working experience.

The professional side of the telephone industry becomes more and more important each year, for the growth of the great network of exchanges and toll lines means not only an alarming increase in the expensiveness of the services, but also multiplication of the technical problems which only specialists can solve. A little rural exchange equipped with new apparatus and a small list of subscribers can for a time be easily run, but with the increase of business and the inevitable depreciation of the plant and the necessity for connection with the outside world, unexpected difficulties manifest themselves—usually too late for the salvation of the company. The various branches of the "Bell" organization long ago discovered that one of the first needs of a system that embraces urban switchboards of most delicate construction and worth hundreds of thousands of dollars—in the case of New York City worth millions—is to have plenty of experts always at hand. A new exchange improperly managed could be made to pay dividends of 15 per cent the first year, perhaps five per cent the second; but by the fifth or sixth year it would fall into bankruptcy.

A jeweler in Boone, Ia., has a collection of watches and clocks that date back hundreds of years and still keep time. One watch with diamond set gold works and silver case is dated 1538. A 1685 watch bears the trademark "Gray's, Bond street, 1685." A clock is dated 1687 and there are two very old clocks having wooden works in his store for repairs. All keep perfect time.

Moved a 150-Ton Steel Oil Tank Down the Allegheny



Moving a Monster Oil Tank Down the Allegheny River

Moving a ⅝-inch steel tank, 80 feet in diameter and 26 feet deep, weighing 150 tons and sunk in the ground to a depth of 7 feet, even a few feet would be a large undertaking, yet such a tank was moved a quarter of a mile down a 30-degree hill, crossing five railroad tracks inside of 40 minutes, placed on barges, towed down the Allegheny river a mile and moved 200 feet up a steep bank to its new location by the Kress-Hanlon Co. of Pittsburg, Pa.

A trench 4 feet wide and 7 feet deep was dug around the tank and 32 holes 4 feet square, 2 feet deep and 8 feet apart were tunneled under the tank and wooden blocks were inserted. Two 5-ton jacks, 64 in all, under each block raised the tank four feet. It was then underpinned with 12-inch timbers; the running timbers were securely fastened with ⅞-inch chains and by means of two horses and the necessary blocks and tackle, crabs and ropes, the tank was gradually moved. At the railroad it was lowered from a height of 38 feet to 6 feet, making a height of 32 feet, which occasioned some trouble with telephone wires, etc. When within 24 feet of the water the tank was moved on five sand barges 16 feet wide and 90 feet long, ranged alongside and held firm by ratchets and ¾-inch steel cables. The tank was rolled into position on the barges and conveyed down the river a mile and thence transferred to its new location.

The work required 24 men for six weeks.

AMERICAN-BUILT SHIP DELIGHTS SULTAN.

So pleased was the Sultan of Turkey with the new Turkish cruiser, Madjidia, built at Cramps, Philadelphia, that he has sent a complimentary telegram to President Roosevelt and a personal message to United States Minister Leishman, commending the high qualities of the American shipbuilding industry. The ship was taken to Mytilene, Turkey, by American officers and crew. Capt. R. D. Bucknam was in command, with Capt. J. Blaine as executive officer. The Sultan invited the officers and crew to visit Constantinople at his expense.

Submarine Coal Mines in Japan

Where the Great Nagasaki Coaling Station Obtains Its Coal Supply

Coal mines operated at depths of 450, 596 and 626 feet below sea level, in seams angling 35 degrees and with constant danger of the caving in of the roof and consequent flooding by the ocean is an industry which enploys thousands of the Japanese and is the source of all the Nagasaki coal supply. Japan is rich in coal from Nagasaki to Yezo, but her most interesting coal mines are those located on four little volcanic islands, Hasima, Nakanosima, Takasima and Yokosima out at the entrance of the long narrow bay of Nagasaki.

Hasima Island

At Nagasaki are gathered ministers and consuls from every nation of the earth; many foreign ships enter the harbor; it is an important center of commerce and every ship that enters the harbor is supplied with coal mined at the island mines out there at the ocean's rim.

Russia has vast beds of superior coal lying undeveloped. Even for her domestic supply she is partially dependent on importation, and now in her time of need, when for her coal is a contraband of war, her navy is handicapped by having no adequate and available coal resource. Meanwhile Japan goes on mining more than she herself can consume. The relative conditions are noteworthy.

All the little islands at the entrance of Nagasaki bay, save Takasima, which is quite high and has some vegetation, are barren knobs rising from the ocean's bed. Little surface they give for carrying on mining operations and aside from the steep angle of the seams, caused by the tilt of the islands, the seams are separated by hundreds of feet of sedimentary rocks and have "faults" which cause great depressions between the islands.

On Hasima island, four seams of coal are worked, the thickest of them being 9 feet 7 inches at 626 feet below sea level. There are only two shafts for the four mines, but the workings, airways, etc., of each mine are kept separate. Safety lamps are used because of gas in the mines and ventilating

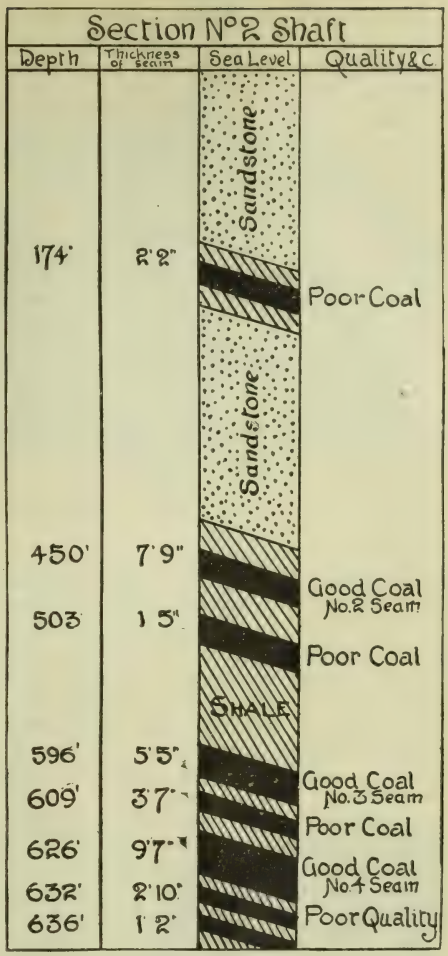
Takasima Island

fans work at each of the shafts. Shaft No. 2 is sunk 700 feet into the seam, where No. 1 level is put in along the strike. Altogether it has 23 levels, 120 feet (slope distance) apart, and the levels are connected every 100 feet by winzes, so that a plan of the mine would resemble a checker board on a slant.

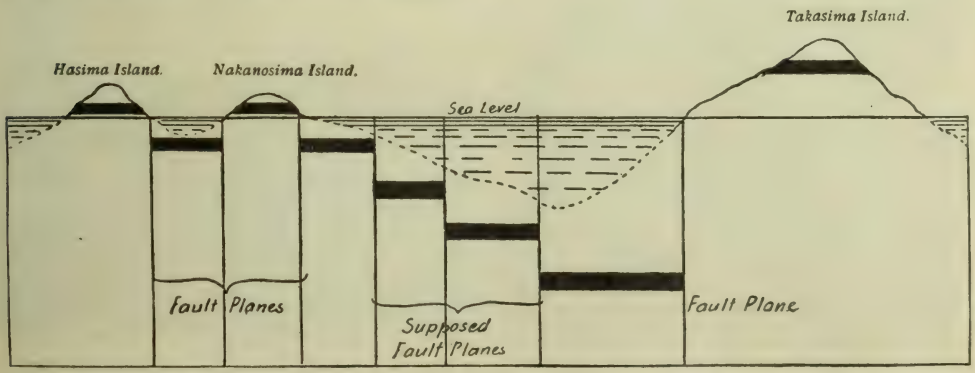
On the main incline, a double-drum winding engine works a double line of rails, hauling 10 trucks of a half ton capacity each. From the levels and winzes everything is hauled to level No. 1 and thence conveyed to the shaft where single decked cages, having two trucks, fitted with safety catches, detaching hook, etc., are hauled by a powerful double-drum engine.

There is little water to be contended with in the mines, but on account of the slope, there is much pumping to be done. From the twenty-third level five sets of Tangye pumps lift the water in five stages to the bottom of the shaft, where there are three large Worthington pumps, two for emergencies and one for use which raises the water in one lift. All pumps, winding engines, etc., are supplied with steam from the surface.

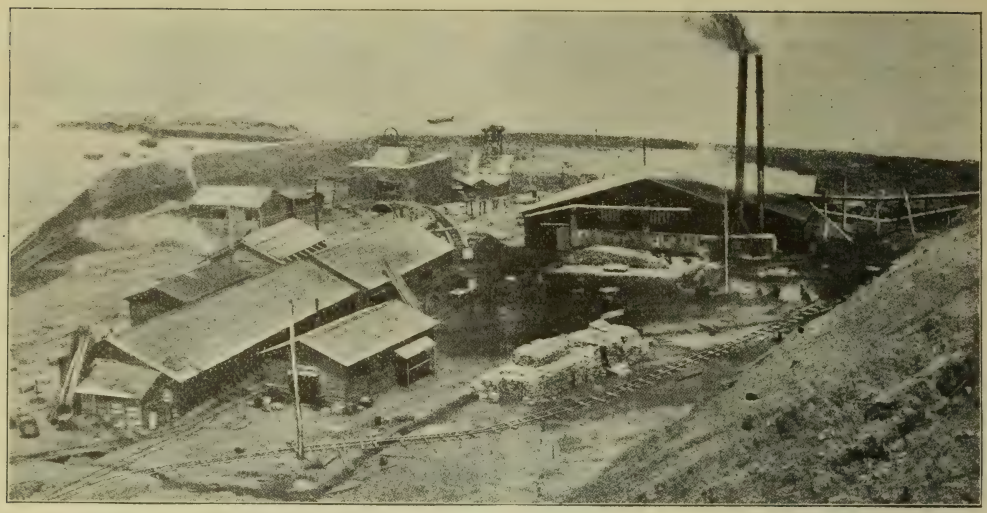
Many Japanese mines are now using compressed-air locomotives in their haulage systems. The air compressor plant is fitted with duplex high-pressure air compressors, fitted with adjustable cut-off valve gear and combined governor and automatic speed and pressure regulator so that the machine responds automatically to the varying pressures and calls for air. The air compressor is connected with the various charging stations by means of pipe of 4-inch, lap-welded wrought iron laid on the haulage floor. The air tanks of the locomotives have a capacity of 68 cubic feet. The standard working



Showing Strata and Seams of Coal



Longitudinal Section of a North and South Line Showing Fault Planes



View of Shafts on Hasima Island

pressure is 800 pounds per square inch. The auxiliary reservoir is 8 feet in length and 8 inches in diameter, with a capacity of 2¾ cubic feet. The reducing valve is placed between the main tank and the auxiliary reservoir with a heavy 2-inch pipe connection. This arrangement is for the purpose of reducing the main pressure to any pressure desired in the auxiliary reservoir, usually to 140 pounds—automatically. It is also arranged to deliver air without reduction to the auxiliary reservoir, when the main tank pressure falls below 140 pounds. The locomotive has a universal metallic coupling attached to an extra-heavy 2-inch check-valve on the main tank to fit a coupling at the charging station.

There is a difference in quality of the coal mined on the islands; some of it is quite inferior, comes under the class known

Road for Surface Transportation Between the Shafts and Shipping Wharf

as "fatty" coals, that is, smokes up things badly and is generally dirty. The Takasima coal is black, lustrous and firm, but light, and must be kept dry as it often fires spontaneously. In all the coal a very low per cent of sulphur is found and some of it yields a long rich flame and has little ash. This is serviceable steam coal and also good gas coal. Certain it is that under the unusual conditions and with the difficulties attending mining in such a locality, Japan, to the complete satisfaction of her own needs and the requirements of other countries represented at her port, has operated her under-sea mines for nearly a century.

SANITATION ALONG ROUTE OF PANAMA CANAL TO BE ENFORCED.

Mortality on the route of the Panama Canal is appalling. Every mile of work done is being paid for, not alone in dollars and cents, but with flesh and blood. Conflicting statistics on the mortality leave the question uncertain, but that it is high cannot be gainsaid. To better these conditions water works and sewerage systems for the cities of Colon and Panama are to be constructed; drainage of intervening districts is to be seen to and sanitary measures will be enforced, all this at a cost to the government of $2,000,000.

FIVE-YEAR SUBSCRIPTIONS.

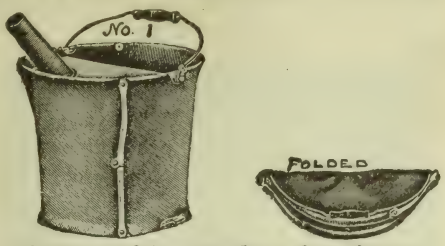
In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

The United States navy is to have three scout ships with turbine engines. The turbine engines are a naval experiment being watched with great interest, and the scout ships are a new departure in our navy, though they have been used in the British navy for some time and their services are valued highly.

If you want any kind of implement or machine and don't know where to get it, write Popular Mechanics. If you do not know the kind of tool best adapted to your needs, write Popular Mechanics and you will get information that you can rely upon.

A FOLDING BUCKET.

A new convenience for automobilists' outfits is a duplex folding bucket. The bucket

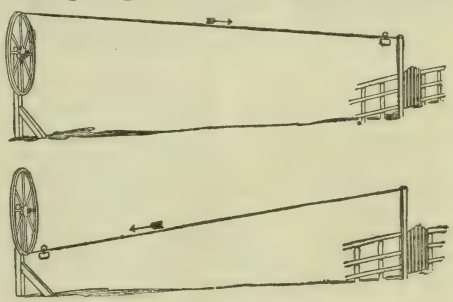


Collapsible Bucket for Automobilists

has a capacity of 12 quarts and when open is as stiff as an iron pail, but folds up like an opera hat, to occupy a very small space.

BRINGS THE MAIL TO THE DOOR.

A device, easily constructed, for bringing the mail from the farm gate to the house on rural routes, consists of a wheel on a stake or a tree near the house; a wire running from a point on the rim of the wheel to the gate post and a small screw wheel



Device for Bringing the Mail from the Gate to the House

pulley put into the top of a mail box and strung over the wire. The wheel is turned a half circle by means of a strong piece of cord tied where the wire is fastened to the wheel. When the wheel end of the wire is up the mail box gravitates toward the gate; when down, towards the house. Thomas P. Martin, Jr., Marlow, Indian Territory, offers the suggestion.

A fire sounded its own alarm in Terre Haute, Ind., a few days ago. The fire caught from an electric wire in a closet. There was a gun outfit in the closet and the fire exploded some cartridges; the family, awakened by the explosion, extinguished the fire.

RELICS FROM THE BURIAL MOUNDS OF NORTHERN MICHIGAN.

In the old mounds of northern Michigan are found many interesting relics. There

Found in Burial Mounds, Northern Michigan

are caskets, tablets, vases, pipes, etc., of clay; also copper arrow heads, battle axes and coins. Nobody has yet been able to read the characters inscribed on them. They undoubtedly belong to a prehistoric age. The students at the State Agricultural College have done considerable exploring and the illustration is from a photograph kindly sent us by C. E. Walter.

ALASKA NEEDS A NATIONAL WAGON ROAD.

Building the proposed great wagon road in Alaska, as recommended by the senate committee, would do more for the development of that far northern American possession than any other step that could be taken just at present. Members of the committee that made the recommendations visited Alaska last summer and made a personal investigation. It was the National road built by the United States government pursuant to the enactment of the National Road Law in 1806 that worked such an important development of the country it traversed.

Much more should a nation, now grown rich and strong, do for the newer territory of Alaska. A wagon road as good as was the old national road extending from the southern coast of Alaska to the interior could be used in the long winters and the short summers. It would put the Yukon valley in communication with Seattle and San Francisco. Over it would be carried supplies for the people already in Central Alaska and over it would go thousands of people to settle along the route or to force their way farther north.

Already the Canadian government has constructed 225 miles of good wagon roads from Dawson to the mining towns. As a result Canadian miners now pay $7.50 for 100 pounds of flour and American miners pay $18.

JAPANESE BADGES DENOTE VOCATIONS.

The Japanese army and navy officers carry the insignia of office, occupation and class plainly upon their persons in the form of

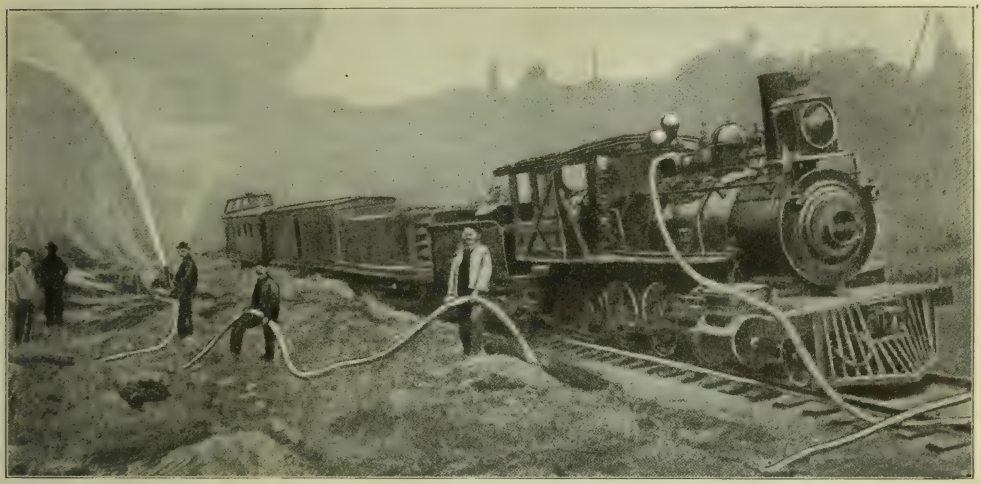
Badges Worn by Japanese

buttons or badges having a design representing each one's particular work. We show a few, most of which appertain to the navy.

During 1903 England consumed $848,937,908 worth of liquor, or an average expenditure of $20.03 for each subject in her realm. This, however, is $25,000,000 less than the record of the previous year.

New York Central's Locomotive Fire Engine.

Fully one-fourth of the fires due to carelessness in the Adirondack forests the past year were charged by the U. S. Bureau of Forestry to the New York Central's locomotives. Now their road is equipped with a heavy 8-driver locomotive with a pump which throws a large stream. The water supply is taken from some stagnant pool near the tracks beside which the locomotive, with a few cars and caboose are drawn up. The pump is connected with the pool by a hose and the train crew sent out to various points along the hose to throw the water. The steam is turned on and the powerful stream of water is played so long as the conditions will permit.



New York Central R. R. Locomotive Fire Engine.

WRITING BY WIRE A TELEPHONE ADJUNCT.

Every Wife and All Persons Must Now Learn to Use the Typewriter, or They Will Be Benighted

Here is an invention that will cause every wife and every husband to learn to use the typewriter, for now the typewriter is to be made an adjunct to every modern telephone. If the wife calls up her husband over the 'phone and he is not at his office, rather than trust someone to deliver the message to him, she simply sits down to the typewriter and dashes off the information she desires to convey to him and even as she writes, the message is being printed at the instrument on her husband's desk; it is ground off on a tape just like the tape of the present ticker machines, and is automatically duplicated on the sender's machine. When the husband returns he looks at the tape and finds the message from his wife and messages from others who may have been communicating with him during his absence.

It is a German invention and the system is called "Electric Distance Printing." So well has it worked in Berlin that plans are now on foot to have it introduced in New York and Chicago as an adjunct to all telephones. A great advantage of the apparatus is that by a simple arrangement the communication can be sent simultaneously to a number of addresses. In this manner, for instance, a person will be enabled to communicate with all the newspapers of New York or Chicago by a single writing of the message on his sending apparatus. Large industrial establishments, banks and newspapers will be greatly benefited and most of them have already subscribed to the new service in Berlin. There it has been made part of the government postoffice service. The telegraph service will also be greatly facilitated, as the main telegraph office can at once transmit all incoming telegraphic messages to any of the subscribers over the new apparatus.

RUSSIA
LONG GROOVED BAYONET FASTENING WITH A COLLAR BEHIND THE FORESIGHT
RUSSIAN CENTRAL MAGAZINE RIFLE SHUTTING WITH A BOLT OVER THE SIDE: FOR A RANGE LESS THAN 500 METRES THERE IS PRACTICALLY NO TRAJECTORY CURVE: THE WEIGHT OF THE WEAPON WITH BAYONET IS 4 KILOS 300 AND THE LENGTH 1 METRE 73
THE MOVABLE BREECH INCLUDES A CYLINDER WORKING WITH A LEVER, A MOVABLE HEAD WITH TWO SYMMETRICAL CLOSING BOLTS AND A STRIKER WITH A COCK AND REBOUNDING SPRING. THE LOADING OF THE WEAPON IS EFFECTED IN A VERY SIMPLE AND RAPID MANNER OPENING THE BREECH THE MAGAZINE IS CHARGED WITH A METAL LOADER A KIND OF SMALL BOX HOLDING 5 CARTRIDGES THESE DEPRESS A SPRING IN THE MAGAZINE BY WHICH THEY ARE RAISED AUTOMATICALLY FOR FIRING
THE BREECH MECHANISM WITH MEDIAN SECTION OF MAGAZINE.
THE BULLET IS NICKEL PLATED, WEIGHS 14 GRAMMES & HAS AN INITIAL VELOCITY OF 620 METRES: THE CARTRIDGE WEIGHS ABOUT 26 GRAMMES AND CONTAINS 2 GRAMMES 2 OF A SMOKELESS POWDER

RIFLES OF RUSSIA AND JAPAN.—The Russian magazine rifle is of the old model. The Japanese rifle with its small caliber, great initial velocity and very low trajectory is essentially modern. The rate of fire of the two weapons is the same, but as regards accuracy, the Japanese weapon is perceptibly inferior to the Russian—more perceptibly in long distance and in wind—a condition caused by the fact that the Japanese cartridge weighs only two-thirds as much as the Russian. The chief difference in the two rifles lies in the trajectory.

JAPAN
THE ARISAKA RIFLE
THE WEAPON IN USE IN FIRST LINE OF THE JAPANESE ARMY. DESIGNED IN 1897 BY COLONEL ARISAKA WHO COMBINED ALL THE LATEST KNOWN IMPROVEMENTS IT HAS A VERY SMALL BORE 6m/m 5 IN WHICH IT RESEMBLES THE ITALIAN MODEL OF 1891.
SWORD BAYONET
IT HAS A CENTRAL MAGAZINE OF THE MAUSER TYPE. ITS BREECH IS ANALOGOUS TO THAT OF THE RUSSIAN BUT DIFFERS IN HAVING THE LEVER OF THE MECHANISM PLACED FURTHER BACK
THE CARTRIDGE, WHICH IS VERY LIGHT, ONLY WEIGHS 22½ GRAMMES. IT CONTAIN A CHARGE OF 2 GRAMMES 11 OF A SMOKELESS POWDER MANUFACTURED IN JAPAN (ITAIBASKI POWDER) THE GUN WITH ITS SWORD BAYONET WEIGHS 4 KILOS 355 AND ITS LENGTH IS 1 METRE 66 IT HAS PRACTICALLY NO TRAJECTORY CURVE UP TO RANGE OF 600 METRES.

To Roll to the North Pole

Strangest Vehicle Ever Built---To Travel on the Wings of the Wind at 75 Miles an Hour

By H. N. Braun

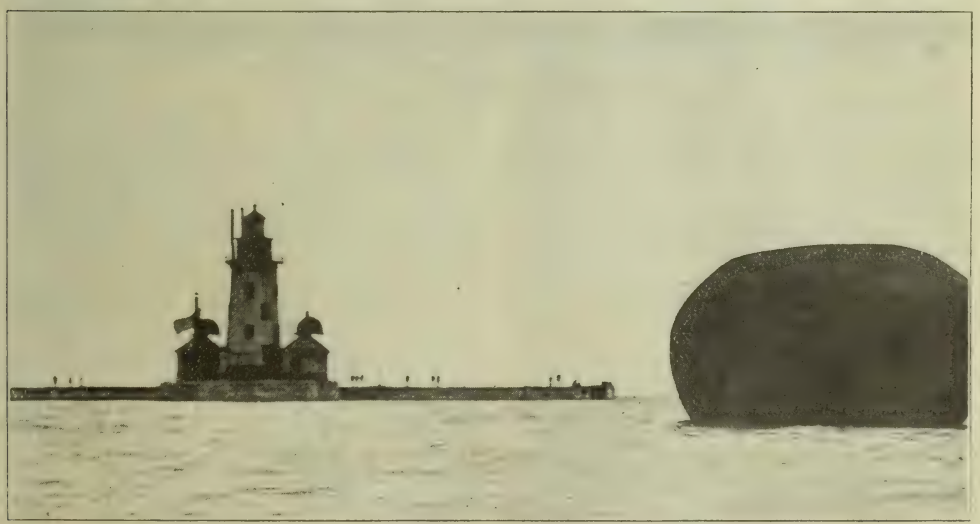
A mammoth football, 115 feet long and 75 feet in diameter, with a seat suspended inside for the rider, is the strange vehicle in which a Chicago man hopes to journey to the North Pole. This great ball is to be rolled along by the wind, and on account of its extreme lightness is expected to go bounding over obstructions as a thistle is driven by breeze.

Peter Nissen

Peter Nissen, who attracted considerable attention in 1900 by shooting the Rapids at Niagara Falls, in an open boat, is about to come before the public again in a new role. This time he appears as an explorer and in the most novel manner, intends to explore the unknown regions of the frozen North. When I say that he intends to roll to the North Pole, very few people take me seriously, and usually look at me and ask, "What is the joke?" I will assure you that Mr. Nissen is not a practical joker, and it is with all the earnestness of a man of science that he is pursuing the object of his dreams. He is not a man of wealth, so it is not for the mere purpose of filling in leisure hours that he has taken up this subject. He belongs to the class of wage earners, and it is during his spare moments that he works, thinks and improves the child of his brain.

His last invention has been termed "Fool Killer No. 3." It is in a vehicle like this he intends to roll to the North Pole.

Already an experimental ball has been constructed and tried on Lake Michigan. This ball is 32 feet long and 22 feet in diameter. It is made of canvas and inflated with air. Through the center runs a steel axle which is held in place by numerous ropes which radiate out like the spokes of a bicycle. On this axle a boat is suspended in which the traveler sits and by sliding his weight from one side to the other he can change the course of the ball. The wind is the motive power and the speed of the ball is dependent entirely upon its caprice. When the wind comes from the wrong direction the air has to be let out



Nissen in His Ball on Lake Michigan Passing Out of Chicago Harbor

and the ball anchored. At one end is a window and at the other end is a small door that will just admit the body of a man. A contraction of about six inches takes place every time one goes in or out. On the inside there is a suction pump to be used tc replace the air that escapes and also supply the necessary fresh air for the existence of the man.

The ball is made of heavy canvas, of a fine texture, the seams being carefully sewed with silk and the outside treated with several coats of waterproof varnish.

Air Pumps at Work Inflating the Ball

The ball I have just described was built only for experimental purposes and short journeys. The advantage being that it can travel over land or sea, and with equal ease can roll over the rugged hills that obstruct the path or float peacefully on the surface of the water. The one he intends to construct for his Arctic expedition is to be much larger, being of dimensions 115 feet by 75 feet.

I asked Mr. Nissen how he came upon this idea of locomotion, and he related the following in the most interesting manner. He said: "I was studying the subject of aerial navigation in regard to its use in the Arctic region and had drawn plans of a balloon with an automobile attachment, with large pneumatic tires, probably 3 feet in diameter, or more. I proposed to travel as far as possible in the balloon and afterwards in the automobile. Since then I have studied over the idea of large pneumatic tires. I began with 3 feet in diameter and it kept growing as I saw the necessity of a larger size. This necessity became so large and the tires so large in consequence that the counterpart of the actual wheel became insignificant in proportion, so much so that it seemed possible to do without it entirely. I then thought of running a shaft through a pneumatic ball, which would make the weight rest on the shaft. The idea gradually grew until it seemed more appropriate to hang the car inside of the tire. This made me think of the auxiliary balloon and from there it was not far to the actual balloon. Think of a pneumatic tire 75 feet by 115 feet! I tell you that it would travel over a small cottage without a jar. There was still the ideas of dirigation and windows and these I have overcome and now I propose to go as far as possible in a balloon and when the lifting power is gone, and it is impossible to keep it above ground, I intend to let the gas out and move inside with boat and provisions, fill it with fresh air and wait for the proper wind and its consequences.

"During most of the three years that Dr.

Nansen has been in the ice he looked for high points in the pressure ridges in order to climb them to look for another ice. He says, 'On May 19th, I climbed to the top of the highest hummuck I have ever mounted. I measured roughly and made it out to be about 24 feet above the ice, but as the latter was considerably above the surface of the water, the height was probably 30 feet.'

"Now give me this balloon filled with air to the pressure of ½ ounce to the square inch; give me an ordinary Northwestern blizzard at the rate of 75 miles an hour, and I will guarantee to travel over such hummucks faster and smoother than the Empire Express on the finest track in Christendom."

Mr. Nissen has complete faith and confidence in his enterprise. On Sunday morning, April 24th, he made a trial trip on Lake Michigan very much to his satisfaction. Shortly after 10 o'clock in the forenoon Nissen arrived at the water edge, accompanied by a number of his friends whose duty it was to heave on the air pump and fill the ball with air. When the ball was inflated he climbed inside and amid the cheers of his assistants was rolled into the lake. A naphtha launch was retained to follow the ball to be at hand in case of an emergency. After running between the Chicago Yacht Club and the Columbia Club the ball made some progress on its course. There was very little wind, and the lake was as smooth as glass and the progress in consequence was slow. After reaching the pier at Park Row the ball was towed back to its starting place, Nissen still remaining within the ball. The official time for the round trip was one hour and thirty minutes; the distance about two miles. When he emerged from the ball he wore a smile of contentment, and said that if the wind had been a little stronger he felt sure that he would have rolled over the pier as easily as a baseball over a peanut.

The second trial trip was made Sunday, May 15th. On this venture it was Nissen's intention to cross Lake Michigan. A good wind came from the northwest early in the morning, but it shifted to the northeast before the time set for the start, making it impossible for him to carry out his plans, but nevertheless a small boat was hired to tow the ball out against the wind to the new pier. Here the ball was pumped full of air and while the jests of the curious, who had come to fish, were resounding in his ears Nissen entered his "Fool Killer No. 3." The ball was then towed out into the wind and set adrift. The wind blew fairly strong, but the ball showed no disposition to roll. It drifted down about a mile and a half toward the shore and was towed the rest of the way in by boat. Nissen was by

The Ball Partly Inflated

Nissen Emerging from Ball

no means discouraged and as soon as the conditions permit he will attempt his trip across the lake.

The cost of these experiments have been borne entirely by himself, as has everything else pertaining to his invention. Up to the present time he has spent about $400, and expects to spend considerable more before he has gained sufficient confidence among the people to back him up in his Arctic expedition. It is not for mere financial gain that Mr. Nissen is working along these lines. He has turned down several tempting offers from managers of amusements and shortly after his venture at Niagara had an offer of $200 a week, which he refused.

Mr. Nissen is a B. S., having graduated from the Normal School in Indiana. He has pursued various occupations, and at one time conducted a business college. He is now employed as a bookkeeper by a large manufacturing concern in Chicago. He was born in Denmark, but has been in the United States for the past 25 years and is a thorough Chicagoan.

THE DEADLY FOURTH.

The penalty of the observance of July 4th in Chicago last year was 19 killed, 314 injured and a fire loss of $103,000. The record of 10 years in 10 of the leading cities of the country is 1,110 killed, 5,593 injured and property to the value of $5,659,000 burned up. The dynamite firecracker, the toy pistol and the big rockets are largely responsible. If we must have this demonstration of noise, smoke and fire, it should be so regulated by police control that people not participating have some protection and not be put in jeopardy of their lives for 18 or 20 hours each year.

THE HANDLESS CLOCK.

At Last a Sensible, Practical Method of Reading Time

The hands on clocks of every description have been making their rounds for centuries, but now they are literally to "go," and with them the familiar dial face as well. One of the first things, and one of the hardest, a child learns, is to read time; and even when grown to mature age he is often puzzled to know whether the clock says 1 o'clock or 5 minutes past 12. All this is to be changed, the hour and minute will be read at a glance, and mistakes will be impossible. The time will be read as railroad men read it, not three minutes after 10, but "10-3." The new practical, sensible clock shows the hour at the top, and the minutes past the hour below. The hour figure changes every 60 minutes; the minute figure at the end of each minute, hence a quarter to six would read "5" in the upper panel and "45" below—5:45. For the even hour the word "o'clock" appears

Clock Without Hands or Dial

in the space where a minute later the figure "1" will appear.

For the busy man, the handless clock is worth its weight in gold. Placed on his desk it cannot fail to attract attention, and the visitor who is inclined to delay is reminded each minute of the passing time. Every 60 seconds a new figure appears, and he is made to realize how long he is remaining without even a hint from the owner who is anxious to have him get through and give others who are waiting a chance.

Japs--The Modern Spartans

Incidents and Illustrations from the Seat of War

General Sassulitch, who lost the battle at the crossing of the Yalu.

General Kuroki, Japanese hero at the crossing of the Yalu.

The Japanese have justly earned the title of The Modern Spartans.

Their daring, their utter disregard for personal danger, and the charge of their land forces into the jaws of certain death, quicken our pulses and command the admiration of the world. The days of Thermopylae; the impetuous, bewildering maneuvers of the Russian Cossacks of a thousand years ago; the patriotic sacrifices of our own countrymen in the days of '76 are all being repeated in the modern cosmopolitan soldier—the Jap.

Nor is the Russian a foeman unworthy of their steel; the rank and file have defended their positions to the last ditch and breastwork, but there is lacking on their side that patriotism which makes death for one's country a joyful sacrifice. The Russian commanders moreover have been outgeneraled week after week, and have defended where they should have attacked.

"Good-bye, and don't return alive until we have conquered." This is the last parting word with which the mothers, wives and sweethearts of Japan send their loved ones to the war.

As a troop train was leaving Moscow for the far East a few days ago, the Russian women threw themselves upon the track in front of the engine in their last desperate protest against the conscription of their husbands and sons. Sixteen times the train was started, and sixteen times the engineer applied the brakes and brought it to a stop to avoid the slaughter of frantic women. At last in a rage, the commander gave an order which the engineer dared not disobey, and the regiment was borne over the mangled, bleeding bodies of their own flesh and blood.

These two incidents dramatically illustrate the existing sentiment of the mass of the people in the two nations.

During the past month the land forces of the Japanese have occupied the place of interest, as the navy did the preceding weeks. With a secrecy never before accomplished by any nation in modern times the armies of the little brown men have been transported, landed, and marched to appear at long distances from the coast as if by magic. As the sun went down upon the Russian camps there was nothing to disturb or cause alarm. Before daylight the call to arms was sounding and the battle was on.

The ability which the Japanese officers have displayed on land and sea and the efficiency of the men and their arms has been a revelation to all the world outside of the United States and England, and has won for the little island in the Yellow Sea her place among the great powers.

The battle of the land forces on the Yalu river was a crushing defeat for the Russians. Corrected reports reduce the total loss to about 2,000 killed; but the Russians also lost 28 pieces of artillery and their position.

The battles at the Russian defenses on the peninsula, which were thrown up to protect the approach to Port Arthur, were fierce and bloody conflicts, and the exact losses in men have not yet been confirmed. The repeated charges by the Japanese up the steep unprotected hillsides, over the dead bodies of all their comrades who had gone before, and under the withering fire of rapid fire guns writes a chapter of unexcelled valor in the history of battles. These attacks lasted several days and nights

before Kinchow was taken. For the first time electric searchlights were used in actual land attacks. The Russians planted portable electric light machines at the top of the hills occupied by them, and the attacking forces were obliged to come out in the open and charge under the glare of numerous blinding lights; while the defenders mowed down the cleverly defined targets.

Dalny, the port on which Russia had spent millions of dollars, was captured and occupied by the Japs. Telegraph communication out of Port Arthur has been cut off for days and the only information from the doomed fortress is an occasional rumor brought by escaping Chinamen, or passing junks.

Cossacks in Box Car of the Trans-Siberian Railway, on the Way to the Front

At this writing the fall of Port Arthur is hourly expected. General Kuropatkin's plan to march to its relief has evidently been abandoned. While the possession of Port Arthur is of no great strategic value to the Japs, beyond relieving Togo's fleet from guard duty, its loss will be an overwhelming defeat to Russia, and will undoubtedly be made an excuse for offers by neutral nations to try to bring about a settlement between the two belligerents. Whether Russia will have the good judgment to accept these overtures is very uncertain. The Russian people would welcome it; the czar is so vacillating he one day favors peace and the next plans for a long war; the Russian officers, who are getting rich out of a war they are responsible for, want it continued indefinitely.

The Vladivostock fleet has been little in evidence, but is now reported to be in the Korean straits, where a fierce battle is raging near Tsunoshima island. The excuse for the inactivity of the Northern fleet that the harbor was closed with ice no longer holds good.

The Baltic Sea fleet is said to be getting ready to sail for the east, but is not now expected to sail before August 1st. The Sultan has not agreed to let the Black Sea fleet pass the Dardanelles.

Russian Railroad Transportation.

The main line of the great Trans-Siberian railway is still in working order, and men and supplies are going east with more regularity than at first. The ice went out of Lake Baikal on May 16 and the two big ferries are now making regular trips. The ice railway across the lake which cost $250,000 has been taken up, although portions of it were lost in the break-up.

The Russian troops are transported in ordinary box cars, with openings cut for windows, and wooden bunks built across the car. Horses ride in the same car as the men. A small stove is set up at one end of the car on which is the inevitable samovar, constantly steaming with hot water for tea. The men make the best of the crude conditions, and pass away the time with music and singing the national songs. The favorite instruments are the accordion, tambourines and sharp-sounding cymbals.

The expected wrecking of the road has thus far been prevented by the vigilance of the track riders, who frequently pass over every foot of track on the eastern division.

A short time ago the Norwegian steamer "Fortuna" sailed from Bridgeport, Conn., carrying with her the American-built submarine boat "Protector" and two experts from the boat's crew. It was supposed that Japan had purchased the boat.

Funeral of Commander Hirose, Killed While Trying to Save a Comrade in One of the Attempts to Block Port Arthur

Funeral of Commander Hirose.

Commander Hirose, who lost his life under circumstances of peculiar daring, while trying to blockade the entrance to Port Arthur, was accorded a grand military funeral at Tokio. He was struck by a bursting shell, and the only portion of his body which was recovered was no larger than a penny. In the procession two officers at the head carried his medals and decorations. Next followed bluejackets drawing a gun carriage bearing the casket; then his niece, and another relative in evening dress.

Cossacks Patroling Coast to Sight Jap Torpedo Boats

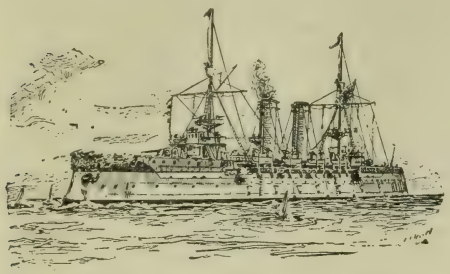
Cossacks Patrol Beach.

A constant patrol of the beach is maintained at Port Arthur and along the adjoining shore. For this work mounted Cossacks are detailed. They are constantly on the alert, night and day, watching for the approach of the Japanese torpedo boats. When the enemy is sighted the Cossacks ride at full speed to Port Arthur and give the alarm.

Japanese Naval Losses.

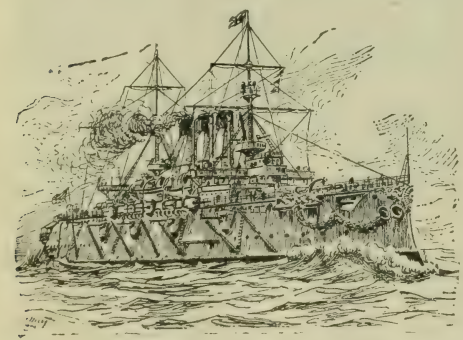
During the past month Japan has received its first serious naval loss in the destruction of the fine battleship Hatsuse, which was blown up by a floating mine 10 miles out at sea. The cruiser Yoshino was rammed by one of its own fleet during a fog.

The sowing of floating mines by the Russians is likely to call forth a strenuous protest by neutral nations, whose merchant craft are thus put in great jeopardy. These



The Japanese Cruiser "Yoshino"

mines are set adrift and, carried by ocean currents, are liable to do their deadly work hundreds or even thousands of miles away, and months after their release. Floating mines are buoyed to float a few feet below the surface of the ocean; two of them are fastened together by manilla rope. When a vessel passes over or near the mines the



The Japanese Battleship "Hatsuse"

rope is drawn into the propeller, which draws the mine up until it strikes the hull of the ship and explodes.

The Hatsuse was built in England in 1899; was 400 feet long; displacement, 15,000 tons; horsepower, 15,600; coal supply, 1,690 tons; speed, 19 knots. The Yoshino was 360 feet long, with 15,700 horsepower and a speed of 23 knots. She was built in England in 1892.

Field Observation Towers.

The Japanese are availing themselves of all the very latest inventions and mechanical ideas, some of which are used for the first time in actual warfare. Their mastery of the operation of wireless telegraphy has enabled them not only to use it in communications between their own vessels, but to intercept and read wireless messages which the Russians were sending. On several occasions they have been able to so work their own instruments as to render the operation of the Russian

Japanese Field Observation Tower

system useless. The field telephone has also been extensively employed. The field observation towers of the Japs are in constant use in the army. The towers are erected with spars or trees, and so proficient is the training of the corps they can erect a tower 100 feet high in an hour or less. It carries an observation platform or crow's nest at the top, from which the intrepid lookout reports by telephone to his officer below. A rope ladder is used in making the perilous ascent.

Hospital Work.

The Japanese soldier is said to fear death less than any fighter in the world, nevertheless the Red Cross work is splendidly equipped and managed. There is a fine Red Cross hospital at Tokio and two hospital ships. The field corps are well trained and have won great praise for their care and attention to the wounded.

The Russians have had much longer experience in military surgery, and the Red Cross work is one of the few things which has enlisted the sympathies of all classes. An interesting feature of this field work is the use of trained dogs to draw an ambulance. Large numbers of these dogs have been sent to the front.

The Splendid Work of the Japanese Red Cross Society

Electric Railroad Tricycle.

A large number of tricycles, for the use of officers, have been built for use on the government railways. The machines carry one person, are operated by electric motors driven by storage batteries, which are carried in a closed box.

Electric Railroad Tricycle Inspecting the Trans-Siberian Railway

Searching for Victims of the "Petropavlovsk" Disaster.

One of the saddest tasks which has fallen to Russian sailors and soldiers during the present war is the search for the bodies of comrades who went down in the appalling disaster to the "Petropavlovsk."

A Japanese squadron had been sighted from Port Arthur and the Russians immediately pursued them. But Japanese strategy, which has become the marvel of nations, had reinforcements near and when about 15 miles out, the Russian vessels, closely pursued, were forced to put back toward port. While entering the roadstead and only a mile out, the "Petropavlovsk" struck a mine and sunk, carrying with her more than 600 men, among them General Makaroff. Since then the shore is constantly scoured for bodies of the victims. Many have been recovered and buried with military honors.

While by no means so terrible, a similar accident befell the Japanese recently while they were making their ninth attempt to block Port Arthur. Their ship "Taihoku" was engaged in laying mines at the entrance to the port when one of the mines exploded, injuring the ship, but not seriously, killing 20 men and wounding nine.

Russian Cook Wagon Always in Readiness

Traveling Kitchen.

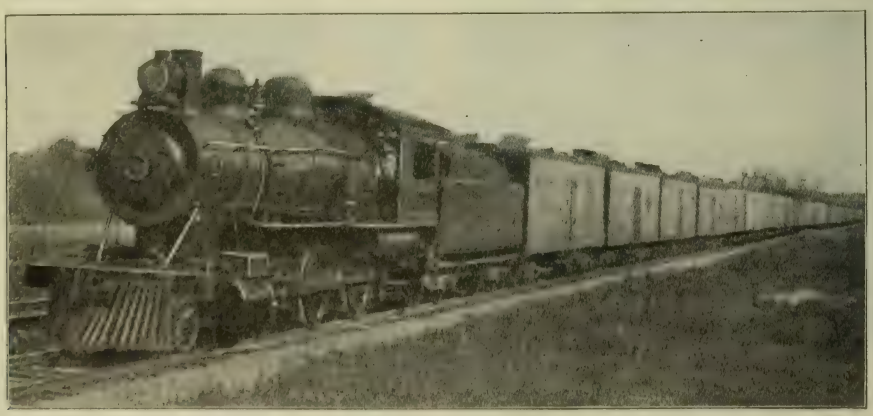
The Russian army, which is fed on meat, bread and tea, carries with it a portable kitchen, or cook wagon. This is in constant operation night and day. The steel boiler has a capacity of 40 gallons. The troops forage as they march, and into this boiler are thrown pigs, fowls or game which may be secured. The contents of the boiler simmer and cook as the troops march along. Hot water is always available for tea. The Russian troops in the East are said to be on half rations. The Japs have seized a fleet of junks carrying supplies for Port Arthur.

BANANA EXPRESSES.

Whenever the Chicago market needs an immediate supply of bananas, than which probably no fruit is sold in larger quantities, a through express running 923 miles on a schedule of 33 hours, leaves the New Orleans docks to supply the great city's demand. Passengers can travel only eight hours faster than the banana express' time. The express shown in the cut comprised 34 cars, carrying 438 tons of fruit.

A perfectly equipped lighthouse constantly in charge of some capable keeper will be a unique feature of the St. Louis World's Fair. It will probably be of interest to many inland people but an inland lighthouse can never equal a real one.

Prof. M. Curie, the discoverer of radium, says: "I was a veritable duffer in school. My teachers said that I was the worst scholar that ever lived."



Banana Express, New Orleans to Chicago

The Invasion of Tibet

England is Unlocking the Door to this Strange and Little Known Country

With the Himalaya mountains for their ramparts, their peculiar climate as a strong ally and animated by their native spirit of seclusion which has ever repulsed the inquisitive advances of other nations, the dauntless Tibetans are valiantly resisting the invasion of the British Mission and its steady advance toward Lassa, their traditional sanctuary, forbidden to strangers.

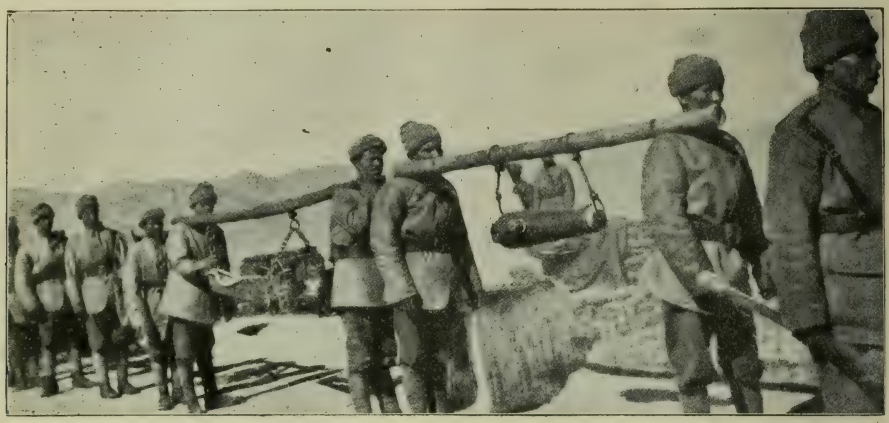
Firing Jingals from a Mountain Fort

So closely has the country, lying between Russia and India on the north and south and with China, to whom it is tributary, on the east, kept her own council in years past that little is known about her. Her customs, her national and industrial development, all have been religiously guarded from foreign inquisitions. In the encyclopedias little may be found concerning her. To diplomatic relations with India her authorities turned a deaf ear, although it was claimed that she frequently violated the British frontier and the complaints were loud and many. Finally, determined no longer to be ignored, Colonel Younghusband accompanied by a strong body of Indian troops under command of General Macdonald was dispatched into the interior of Tibet, across the mountain passes of the Himalayas, 130 miles from the Indian base of supplies, to Gyangtse, 114 miles from the sacred capital, Lassa.

At Guru, two days' march from Gyangtse, the intrusion of the British was spiritedly repulsed by several thousand Tibetans, who had entrenched themselves behind a wall flanked with stone sangars. The Indian troops were ordered to disperse them without arms, and the Tibetans answered with a fierce attack. The troops fired and the Tibetans were forced to flee, leaving about 500 dead and many wounded strewing the field of the conflict.

But the Tibetans were not cowed by defeat. Their priest, the Grand Lama, who dwells in the sacred city, incited them to hold intact their national and, to them, sacred right of seclusion. Deluded or not, the same spirit that stirred the revolt of the American Revolutionists, the Poles, the

Cubans, the Boers and the American Indians, kindled their spirits to the high resolve to do or die. Such a spirit smears fields with life-blood before it yields.



Tibetans Carrying Mountain Guns While on the March.

Before reaching Gyangtse another engagement, in which many Tibetans fell, was fought. But the mountain passes between Gyangtse and Lassa, which point had now come to be the objective of the British Mission, were well fortified by the Tibetans, and the camp at Gyangtse is under continual fire from an old fort or jong, 1,400 yards distant. Here they have mounted jingals, breech and muzzle-loading, and while their military training is hardly worthy of mention they have successfully held up the Mission. These jingals are 8 feet long and the balls weigh from one to three and one-half pounds. Prongs, stuck into the ground to resist recoil, form the stands for the breech-loaders. The breech-piece containing the charge is inserted; the ball is inserted into a horizontal slit in the side of the gun to keep the rear of the breech-piece in position. Some of the weapons have foresights and backsights.

Delayed as the Mission is, it is probable that some fierce fighting will take place before its object is accomplished. The climate is intensely cold in winter and very dry; the Indian army is not accustomed to these conditions. It is far from their base of supplies. Soon the mountain passes will be blocked with snow. Supplies for the present force must be hurried across. Reinforcements cannot be sent because of the difficulties of sending supplies so far for so many. The world is watching for interesting developments in Tibet.

NEW KIND OF PROPELLERS ON AIRSHIPS.

A Californian has invented a flying-machine with a new kind of propellers. The machine comprises an oblong kite-shaped aeroplane of air-tight silk canvas, containing 300 square feet, mounted over an inner and outer band, or hoop, and will serve as a parachute in case of accident to the machinery, or in descending. There are two uplifting, neutralizing propellers, one 8 feet and the other 6½ feet in diameter, and two advancing and driving, neutralizing propellers, each 4 feet in diameter. The propellers are constructed on the bicycle principle, but have an inner and outer rim, between which are fastened strong aluminum blades or fans arranged in groups of eight in the larger and four in the smaller wheels. The propellers are placed in linear sections so that when in motion they pass over different air currents at the same time, affording the results of several wheels combined in one. Their combined weight is 40 pounds and they have 56 square feet of blade surface.

The entire mechanism of the airship is fastened together around the central hub.

Rural Produce Exchange Conducted by Telephone.

"Hello, Central, I want some tomato plants."

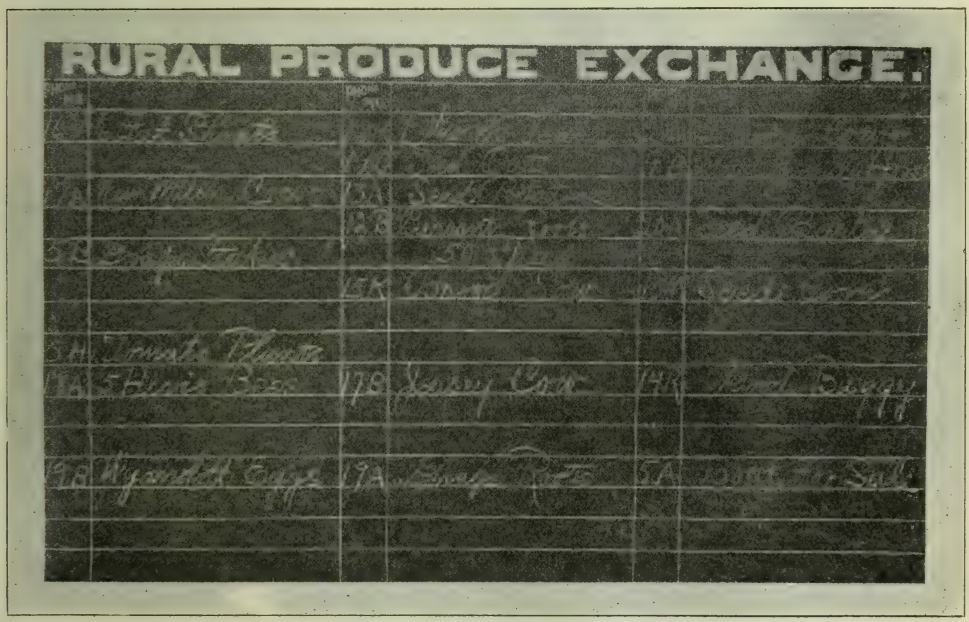
"Buzz, buzz: All right, there you are," as the operator connected the calling phone with phone 5 H.

"Central? Say, I want to sell my boat. Number of my phone? It's 5 A. You have put it on the board? All right, thanks."

And that is the surprisingly modern manner in which the subscribers of a rural telephone exchange make their wants known and find things they need, without ever going out of doors and without driving all over the country.

telephones in to inquire whether there are any seed potatoes for sale that day. He is given the number of any person whose number appears on the board, as having seed potatoes. The would-be purchaser calls up the number and the chances are that the deal is consummated then and there, thus saving time and trouble.

There have been many cases where sales and purchases made in this manner have been an actual saving to the parties. The idea has done much toward making the telephone service popular among farmers and others. on the line.



Quotation Board in Penn Yan, N. Y. Telephone Exchange.

A telephone rural produce exchange has been established in Penn Yan, N. Y., and has proven a great success, 200 new telephones having been installed on the rural lines since the execution of the idea.

Really the exchange is an information central. If a subscriber has produce, implements, or possessions of any kind for sale, he telephones the fact to the exchange and his telephone number is written on the board and the item for sale opposite it. In this way many items come to the exchange board. Then perhaps another subscriber

HOW TO CLEANSE COPPER VESSELS.

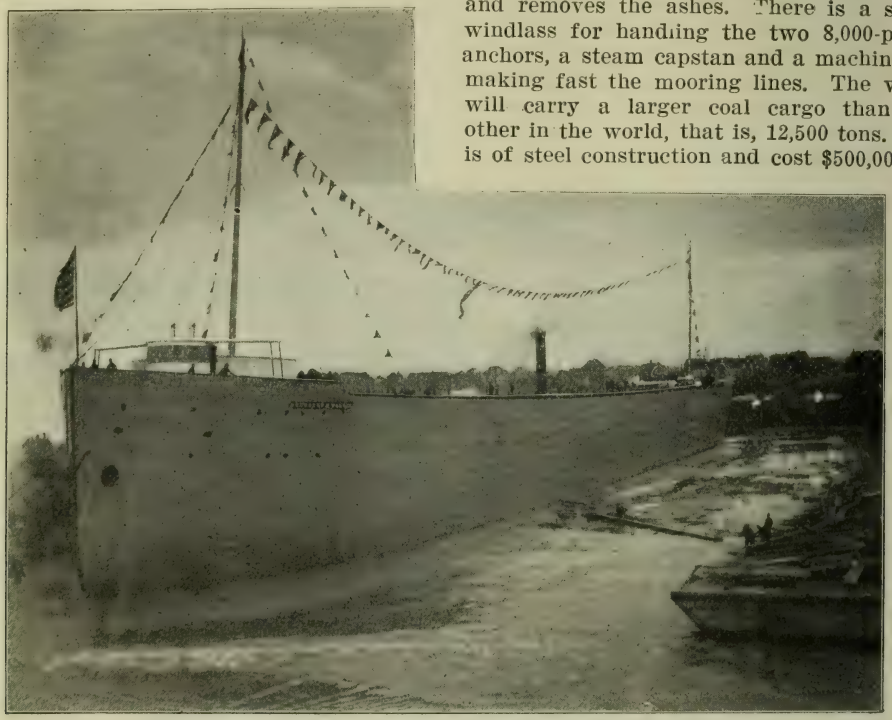
Make a stiff paste of soft soap, rottenstone and water, dissolving by gently simmering in a water-bath. Apply with a woolen rag, polish with dry whiting and rottenstone and finish with leather and dry whiting.

The center of population of the United States is six miles southeast of Columbus, Ind. The center of area of the United States, including Alaska and all the new possessions, is in northern Kansas.

Largest Fresh-Water Steamship in the World.

The largest fresh-water steamship in the world, the "Augustus B. Wolvin," is 560 feet long (62 feet longer than any steamship on the Great Lakes) and is almost automatic in its every feature. Every labor-saving device possible has been used in her construction and very few men are required in the crew, machinery taking their places. The great hopper-shaped hold is 409 feet long and has 33 hatches which open by machinery and the vessel can be unloaded quicker than any other vessel in the world and by machinery.

Automatic machinery feeds the furnaces and removes the ashes. There is a steam windlass for handling the two 8,000-pound anchors, a steam capstan and a machine for making fast the mooring lines. The vessel will carry a larger coal cargo than any other in the world, that is, 12,500 tons. She is of steel construction and cost $500,000.



Largest Fresh-Water Steamship in the World.

THE SOUTHERNER UPLIFTS THE NEGRO.

Thomas J. Calloway, an American writer, believes that the solution of the negro problem depends on teaching the negro the mechanical arts. He says that prior to the Civil War there were many negro mechanics in the southern states. They were expert blacksmiths, wheelwrights, wagon-makers, brick masons, carpenters, plasterers, painters and shoemakers. The intoxication of sudden emancipation tended to draw the negro away from industrial pursuits. To get the negro back to the soil and to mechanical industries is the work of such schools as the one at Hampton, Va., and the one at Tuskegee, Ala.

In making a tour of 57 manufacturing plants in southern cities Mr. Calloway found 7,244 colored employes. At Atlanta colored men were found doing skilled labor in the manufacture of fertilizers, chemicals, wagons, buggies and shoes. They were generally employed in all branches of the building trades. In Birmingham, Ala., they were employed in the production of pig iron and steel, holding the responsible positions of furnace-keepers and iron graders. At Knoxville, Chattanooga and Richmond they were employed as blacksmiths, molders, puddlers and machinists' helpers. In Knoxville, Tenn., hundreds of negroes were employed in chiseling and shaping Tennessee marble.

Transportation at the St. Louis World's Fair

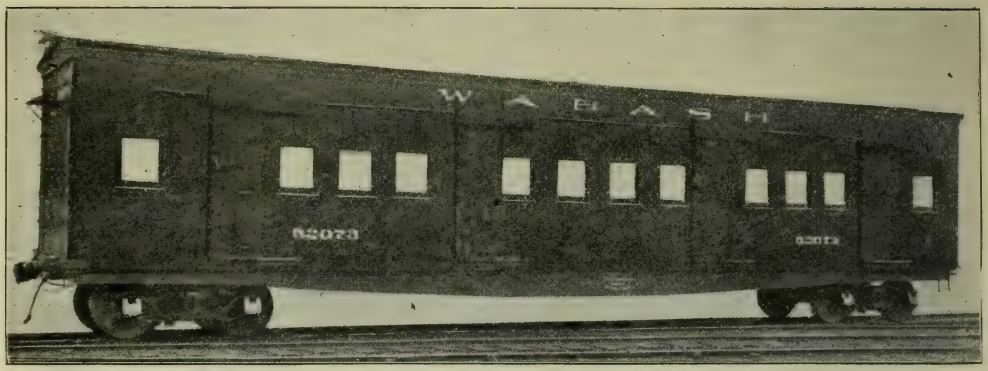
Open Electric Vehicles for Sightseers at the World's Fair.

Visitors to the World's Fair this summer need have no apprehension concerning transportation facilities. Ample provision has been made by all the street car companies and every kind of conveyance imaginable is in evidence and each person may suit his individual taste. The street car lines handled the traffic successfully on the opening day and it is estimated that the three city lines to the grounds can carry 75,000 people an hour.

Probably the most efficient feature of the provision made is the flexibility of the lines accomplished by numerous terminals, so that wherever the demand for service is greatest, cars may be had to meet that demand.

Congestion at the great Union depot is to be avoided by landing passengers on incoming trains from the east, at relay depots in East St. Louis. At these points passengers can take a street car line across the Eads bridge to Third and Washington streets in St. Louis, at which point numerous lines pass, and electric cars may be taken direct to the grounds. Private trolley cars may be chartered in East St. Louis and will go through to the Fair without further change. This will afford a pleasant and inexpensive

Exposition Electric Car that can be Turned into a Closed Car in a Few Minutes.



Wabash Shuttle Car for World's Fair Service

means of conveyance for parties traveling together.

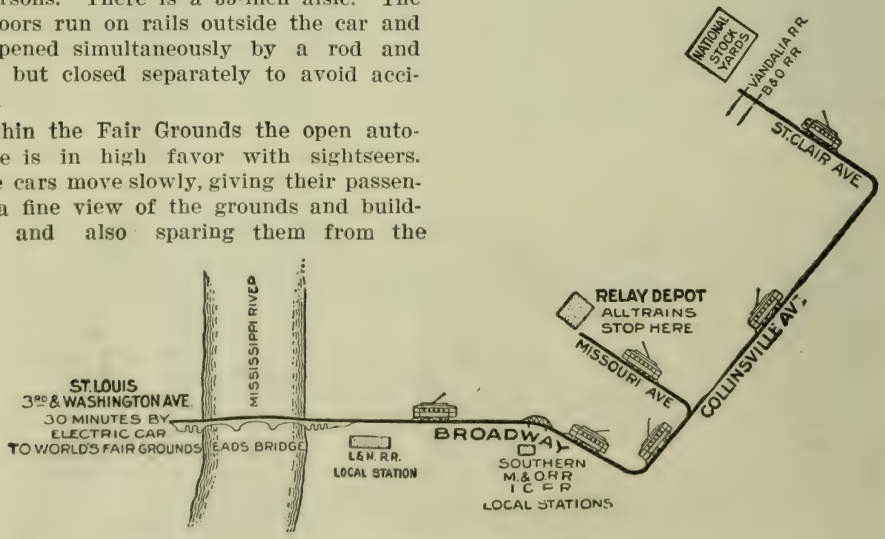
On the St. Louis lines, the usual cars will be used and also new convertible Exposition cars, the open sides of which afford a fine outlook. Between Union station and the Fair grounds the Wabash railway will run shuttle cars, of which it has had 150 built for the temporary service of the Fair, afterwards to be converted into standard furniture cars. The cars are 50 feet long inside, 8 feet 9 inches wide and 8 feet 9¾ inches high. The seats are arranged with a seat clear across the car at the end for six persons, three sets of double seats, two sets of single seats, three sets double seats and another end seat, and they will accommodate 92 persons. There is a 35-inch aisle. The car doors run on rails outside the car and are opened simultaneously by a rod and lever, but closed separately to avoid accidents.

Within the Fair Grounds the open automobile is in high favor with sightseers. These cars move slowly, giving their passengers a fine view of the grounds and buildings and also sparing them from the crowding and jostlings endured by others less favorably located.

On the lagoons electric launches having 2½-horsepower motors are in use. They have a speed of four and one-half miles an hour and form a delightful means of traveling about on the water.

Private automobiles can be taken into the grounds by paying 50 cents admission for the machine. Auto buses also leave the principal hotels every 15 minutes.

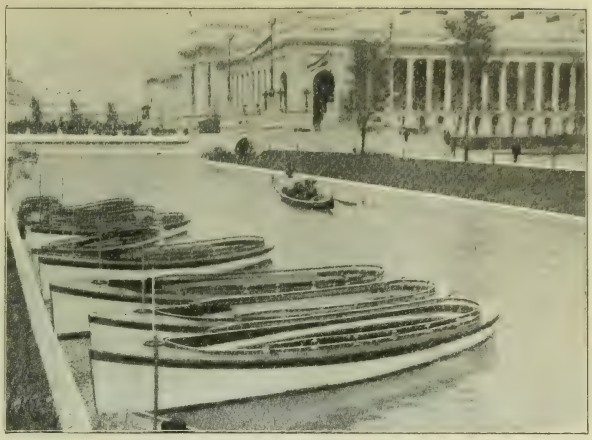
On the opening day of the Fair, the St. Louis Transit Co. carried 927,000 persons with 1,000 cars in use, the St. Louis & Suburban, 94,000 with 110 cars, and the Wabash shuttle trains 16,514.



East St. Louis Street Car Line which Will Carry People from Several Depots Across Eads Bridge to Terminal of Line to the Fair Grounds

During the World's Fair at Chicago, there were two occasions, July 4th and "Chicago Day," when vast crowds of people were waiting at 12 o'clock at night for some means of leaving the Fair Grounds. The emergency was so unexpected that the companies were not adequately prepared to handle the crowds. To hold such masses of people for a length of time is always a menace to safety of body and property.

The well-stored loops at the St. Louis Fair Grounds will to a great degree eliminate a like danger. Doubtless before the Fair closes the number in attendance will be increased by many thousands over that of the opening day. At the southeast corner of the Fair Grounds is a loop which has storage track capacity for ninety cars. On the north, where there are four transit loops and two suburban, a main car yard with 500 cars in storage is only 1,500 feet from the two principal loops, to which cars can be run in two minutes, and to more distant loops in four and six minutes. Altogether there are six transit and two suburban loops and all are directly connected. So much of the visitor's pleasure and comfort depends on the transportation facilities that the extensive provisions made in this line are sure to receive hearty commendation everywhere.

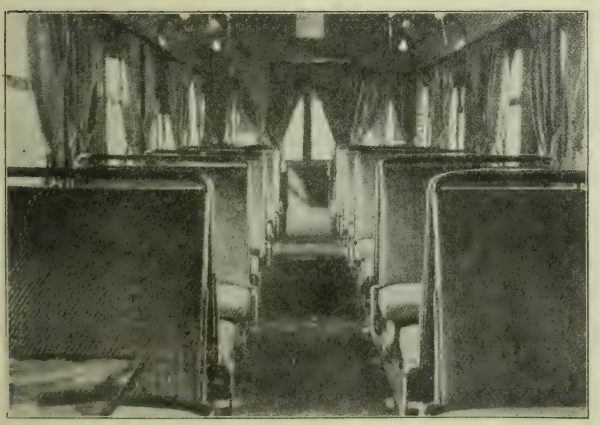


Electric Launches for Carrying Visitors About the Lagoons at the World's Fair

GOING TO THE FAIR IN ROWBOATS.

While others are speeding across the country in automobiles, palace cars and Pullman sleepers toward St. Louis and the World's Fair, several little rowboats, each carrying a couple of young men, are paddling their way down the Mississippi to the same destination and their occupants are probably enjoying the most novel and wholly delightful adventure of their lives.

Two students of an Ohio university are making the trip in a 16-foot rowboat. A Wisconsin man and a friend are traveling by way of the St. Croix river and the Mississippi in a little birch bark canoe, such as the Indians used when they alone paddled up and down the great Father of Waters. A Chicago man will go in an autoboat. Two young men from Honesdale, Pa., will journey by way of the Hudson river, Erie canal, Lake Erie, the Ohio river and the Mississippi in an 18-foot rowboat, while two Chautauqua fellows start in a canoe from Cassoaga creek, travel down the Alleghany and the Ohio and up the Mississippi to St. Louis, the distance being 2,500 miles.



Trolley Car Arranged for Private Parties.—St. Louis Fair

STREET RAILWAYS IN THE UNITED STATES.

The total mileage of the street and electric interurban railways in this country is 24,561 miles. Of this, 281 miles are operated by horse cars, 142 miles by dummy engines, 267 miles by the cable, while 23,869 miles are operated electrically. On these lines are used 7,923 horses and mules; 475 steam dummies, and 52,119 electric motor cars.

First Lessons at the Forge

Every young man, no matter what his intended occupation or profession, should know something about forging, welding and shaping metals. The work is at once fascinating, useful and practical. This series of articles will extend through several issues.

PART II.—BENDING, SWAGING AND WELDING

By A. W. Marcy.

The first lesson in forming should be some simple bending like chain links, rings, hook and staples, etc. For chain links cut off six and one-half inches of ⅜-inch round iron, and heat about two and one-half inches of the center to a bright red, place the hot part over the horn of the anvil and bend to the shape shown in Fig. 1.

This may not be easy at first, but a few trials will enable one to bend them nicely at the first heat. For an S hook, like Fig. 2, cut off six inches of 5-16-inch round iron (a few short pieces of ¼ and 5-16 round iron, also ¼ by ¾ or ⅜ by 1 flat iron can be easily obtained of a neighboring blacksmith), heat half the length to bend each end. For a ring on the end of a rod like Fig. 3, bend first like Fig. 4, then bend the end to a true circle. In bending all kinds of work, heat the parts to be bent to an even heat, as uneven heats are sure to bend unevenly. A staple like Fig. 5 is made by heating each end of a piece of ¼ or 5-16 round iron to a white welding heat and drawing down to a square point, then bending the same as a chain link.

For a hook to go with the staples like Fig. 6, cut off six or seven inches of round iron the same size as staples, draw one end out to a round point for the hook, and bend each as shown in sketch. A few rings of different sizes like Fix 7 is a good lesson in bending, and they should be bent as near a perfect circle as possible.

When the young smith has mastered the principles of bending, he may take up drawing and swaging, which includes punching and splitting. Two or three round steel punches from one-fourth to one-half inch in size for punching hot iron can be obtained of any blacksmith for a few cents. Figs. 8 and 9 show two steps in drawing and swaging. In Fig. 8 one end is square and the other flat, and they are drawn over the corner of the anvil; in Fig. 9 one end is square and the other round, these are also drawn over the corner of the anvil.

The drawing should be done at a good high heat to prevent the fibers of the iron from separating and spreading apart.

When drawing a larger piece down to a round, it should be drawn square first, then the corners hammered down to make the round, as this way is easier and less liable to split the stock.

Figs. 10 and 11 show two lessons in split forging. AA are the pieces completed; BB shows how the iron is split to form the desired shape. A small hole is punched at the proper place, and the piece split open and spread apart as shown. Spread the ends apart over the corner of the anvil, and draw out to shape. Fig. 12 shows another step in forging, which is made as in Fig. 13 by swaging down the necks AA over the corners of the anvil, and drawing down the center like Fig. 12. Trim off the outside corners BBBB, Fig. 13, and round up each end over the edge of the anvil; punch the holes and it is done. Fig. 14 shows a solid forged ring without a weld, and the way to split the stock to make same. Two holes are first punched, then split as shown at A and the two sides spread apart as per dotted lines; it is then worked out larger on the horn of the anvil.

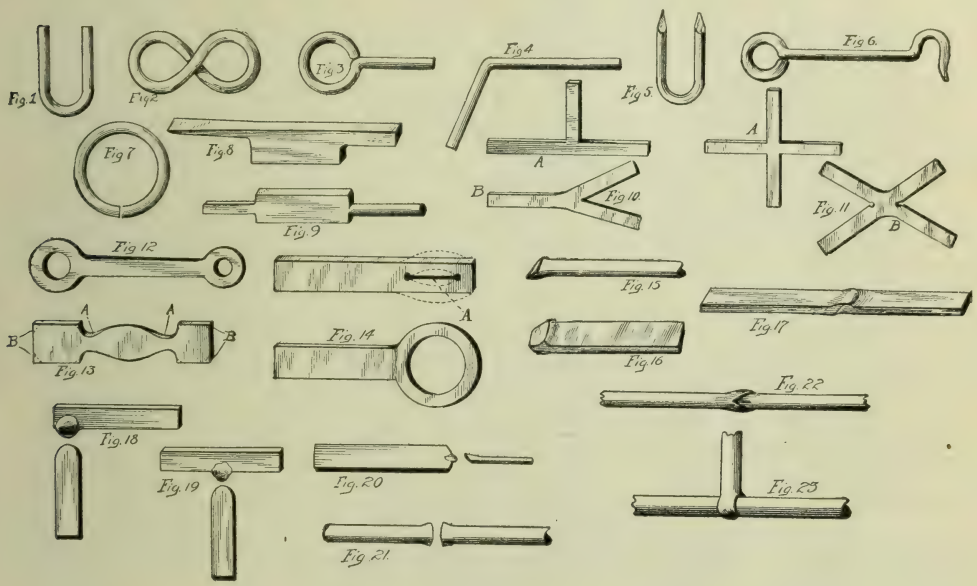
When drawing a ring of any kind, the whole ring should be red hot, if possible, as, if one side is cold, the hot portion in expanding pushes against the cold part, and does not draw so fast.

To those who have an eye for artistic or decorative iron work, twisting will be of interest. This is usually confined to square and flat shapes, although two or more pieces of round iron are sometimes twisted together. The principal requirement in twisting is care and patience, as an even, nice-looking twist requires frequent heating to get it just right. The vise and tongs are all the tools necessary for common twisting, and with a little practice the young smith will be able to make a nice-looking twist.

The next lessons are the different methods

of welding, which require fully as much judgment and skill as any of the previous lessons. Chain links and rings are the easiest to weld, and should be tried first. The chain link should be "scarfed" at the ends on opposite sides, the shape of Fig. 15, making the scarf as short as possible. A short scarf for any kind of a weld is much better than a long one, as it is easier to make, easier to heat, and usually makes a stronger weld.

The proper heat for welding iron is a soft white heat, commonly called a "snowball" heat, which should be hot enough for each scarf to drip molten iron. When at



this heat, if no dirt or "dross" is between the laps, the two pieces will unite in a solid weld. Care should be taken that each lap is hot the whole length, and that no dirt sticks to the scarfs. After scarfing the chain link, bend each end together with the two scarfs well lapped over each other, heat to a welding heat and hammer together, rounding up the weld over the horn of the anvil. Welding a round ring is similar to welding a chain link, except each end is scarfed and bent in the form of a circle. Upset each end a little before scarfing to make the stock a little heavier at the weld. When making a weld of any kind, the two parts to be welded should be upset, if possible, to allow sufficient material for making the weld full size of stock.

If no allowance is made in this way, the weld will be smaller than the original size of stock, as more or less will waste away in welding, and the necessary hammering to produce a solid weld reduces it still smaller. To calculate the amount of stock necessary for making rings, multiply the inside diameter and the thickness of stock used by 3.1416, which will give the number of inches and fractions of an inch. For instance, a ring is wanted of ½-inch round iron three inches inside diameter, multiply three and one-half by 3.1416 and the answer will be 10.9956, but for common everyday work it need not be so exact, and by striking out the three right-hand figures, 10 9-10 will be the length of iron required. If a ring is made from stock bent edgeways, add the width to the diameter instead of the thickness.

The scarfing of both round and flat iron for a lap weld is practically the same, the scarfs should be drawn to a thin point, unless a very wide piece, when the end need not be very pointed, but should be quite thin. Fig. 16 shows the form of scarfs for flat pieces. When placed in the fire for the welding heat, place the scarfed side up until quite hot, then turn over and bring to a good white heat. As far as possible keep a good bed of coals under and around the pieces, and avoid letting the irons get down

in the bottom of the fire, as the cold blast will cool them off.

When ready to weld, grasp one piece with the left hand, and the other with the right, palm down, and as the pieces are pulled out of the fire, turn the right hand palm up, which will bring the scarf side up, the piece held in the left hand lapping over the other piece as shown in Fig. 17. When lapped together let go of the piece held in the right hand, grasp the hammer and weld the two together, hammering both sides alike. If the end of one or both laps does not weld down solid, take a second welding heat, which usually makes a solid job.

Various difficulties may be encountered in welding, but patience will overcome them; expert smiths make failures sometimes. To test a weld in a flat piece, bend a right angle edgeways of the weld, and if it does not pull apart anywhere, it is a good weld.

Fig. 18 shows the form of scarfs used in welding two pieces at right angles, which produces a square corner. Fig. 19 shows the common method of welding a T or brace in the center of a long piece; both pieces should be upset where the scarfs are formed. Fig. 20 shows the method of welding a round piece to a flat piece for strap bolts, etc. A little more skill is necessary to properly heat two pieces which are of diffierent sizes, as the smaller piece is apt to get hot before the larger one, and they should both be the same heat to unite readily.

Large pieces of iron or steel like shafting, large bolts, etc., are often "jump welded," which is done by butting the two ends together at a welding heat. Fig. 21 shows how the ends are formed for such a weld. The ends are upset a little and rounded over to make the centers come together first; the ends are placed in the fire opposite each other, and as they are brought to a welding heat the centers are stuck together. As the heat is increased, they are driven together by striking on the outer end with a hammer or sledge. When the ends are welded solid, the weld will be considerably larger than the shaft, it is then taken out and hammered down to the required size. The object of having the ends rounding is to weld first at the center, and as force is applied to the outer ends, they gradually close up and any dirt or dross is driven out. This is the best and easiest method of welding large shafts. Figs. 22 and 23 show two methods of split welding, which need no further description. Having learned the principles of forming, swaging and welding, we will take up some useful forging in the next issue.

(To be continued.)

Automobile Ambulance for Injured Dogs and Cats

Dog and Cat Hospital Conveyance.

This automobile was especially constructed as an ambulance for injured dogs and cats. It was built for the proprietor of a dog and cat hospital at Cleveland, O. The ambulance responds to calls from all parts of the city where dogs and cats are injured. Sometimes it has as many as a dozen calls in one day. This is the first and only automobile dog and cat ambulance ever built.

The automobile is provided with an upper compartment for cats and a much larger compartment below for dogs.

Highest Dam in the World.

Stupendous Cheeseman Dam in Colorado—236 Feet High and 176 Feet Thick at the Base.

Down in the narrow, rock-walled canyon of the South Platte, in Colorado, at the point where the roaring South fork renders constant tribute to the parent stream, a mammoth masonry dam—probably the largest and highest in the world—rears its majestic walls.

This is called the "Cheeseman Dam," so named after its principal projector, and, with the land surrounding its beautiful attendant lake, containing some 30,000,000,000 gallons of filterable water, it will represent an approximate outlay of $2,500,000.

Constructing the Cheeseman Dam.

With the exception of the upstream face, which is of rough-pointed ashlar granite, with 1-inch vertical and horizontal joints, the entire dam is built of granite rubble blocks, shaped on the spot, and laid in Portland cement, which was hauled over tortuous mountain roads from the nearest railway point some 16 miles away.

From Denver this stupendously high dam is distant about 56 miles by rail, and 16 by stage, and on the guide book of the scientific tourist the world over, it should be numbered among the worth-while sights of the great West.

On the first of July, of the present year, the contract time expires; but already this colossal work is rapidly nearing completion.

At its lowest point the foundation is down to "bed rock" and will average a great many feet across the masonry line. The top of the parapet walls surmounting the lake will reach an elevation of some 221 feet, so that the total height from top to bottom will be 236 feet. At the base, the maximum thickness of the wall is 176, and at the top 18 feet. At an elevation of 90 feet, the extreme length is 130 feet, and on the top 700.

Of course, the construction of this huge dam is principally for irrigation purposes, and with Denver, Colorado's young leviathan metropolis straining to reach the 300,000 census mark, the early completion of the Cheeseman enterprise is hailed with joy. The "water ghost" is to be exorcised —banished for years to come. Irrigation and domestic supplies have been augmented beyond the point of want. "Onward, onward," is now the confident cry of the average Coloradoan.

MILITARY TELEPHONE REPORTS RESULTS OF SHOTS.

In artillery practice the telephone is now used to report the result of the shots from the target to those doing the firing. This means a great saving in time, for often the target is miles from the gun and in firing 20 shots when the information was sent

Telephone in Artillery Practice.

back by relays or "wig-wagged" by signal flags, says the American Telephone Journal, it occupied as much as two hours.

Where the telephone is used a specially prepared insulated wire for conducting the current is laid and the earth carries the return current. Where the line is for temporary service it is laid on the ground, but if to be permanent, it is attached to trees or laid in protected places. The line is grounded in some simple way, such as thrusting a hatchet into the earth and wrapping the exposed end of the conductor around it.

Such a line, three miles in length, can be installed in two hours, and the service it gives is quick and satisfactory.

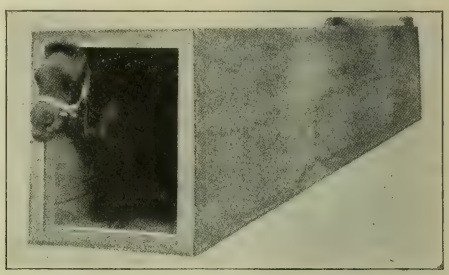
A PORTO RICAN AUTOMOBILE 'BUS LINE.

An automobile 'bus line between Camuy and Aguadilla, in Porto Rico, which places are the terminals of coast line railroads from Ponce and from San Juan, are soon to be established, thus connecting the two cities by a through line.

For its operating field the 'bus line will have a fine macadam road over the mountains, 26 miles in length. The mountain run will be of two hours' duration, and the entire distance (120 miles) between the two cities will be covered in 12 hours. The 'bus fare will be $3.00.

WORLD'S LARGEST ORGAN COMPLETED.

Can a pony walk through an organ pipe? Yes, if the organ is large enough, but there never was built but one organ of such gigantic proportions. It has just been completed and is to furnish music for the visitors to the St. Louis World's Fair. The accompanying illustration is from a photo-



graph of the big "C" of this gigantic musical instrument when a pony was standing inside with his head sticking out. The pipe is 32 feet long. The picture gives the pony a very queer appearance, as if he were nearly all head, but this is because of the photographer's blunder in not getting the proper perspective. The organ will make music so loud that it will shake the walls of buildings and the very ground will seem to quiver, the builders say.

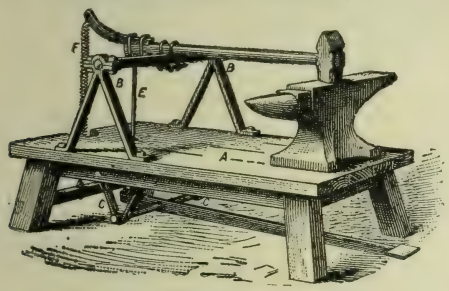
Automobile Stage Car in Porto Rico.

SHOP NOTES

A FOOT-POWER HAMMER.

A correspondent of the Blacksmith and Wheelright describes a foot-power hammer made by him 14 years ago. He says

"A is a wooden bench right height for anvil to set on under hammer; B B are



Foot Power Hammer.

pillow blocks for hammer to swing on; C is hanger for treadle to swing on; D is axle; E is connecting rod from treadle to handle; F is a spiral spring to raise hammer.

EXPLOSION OF A HOT WATER BOILER.

That kitchen hot water boilers are as liable to explode as any others under the right conditions, has been fully demonstrated by an explosion that occurred at a club house near Hartford, Conn., recently. No person was seriously injured, but damage to property to the extent of $2,500 was done, the building having an immense hole torn in one side and other rooms being wrecked.

The boiler was an upright cylindrical copper tank of 300 gallons capacity; had no fire under it, and the water was heated by a water front in a range. The only pressure it was supposed to be subjected to was 65 pounds per square inch from the city water mains and which amount was quite safe.

Investigation, however, showed that a check valve had been put in the supply pipe to prevent the water, when there was enough heat to generate steam in the boiler, backing up and injuring a water-meter on the supply pipe. Of course the water had no exit and the explosion followed.

There should never, for the reason shown, be a check valve in the pipe between a kitchen boiler and a water main, says The Locomotive. The boiler can in no way relieve itself of excess pressure when the water is overheated where there is a check valve. Such an accident could be prevented by providing the boiler with a safety valve. In England "dead weight" safety valves are commonly used on kitchen boilers, this kind of valves being very simple and reliable. A check valve and safety valve might both be used with safety providing the condition of the safety valve was looked after, but it were best to dispense with the check valve entirely.

A stop valve on the supply pipe is a positive necessity to a kitchen boiler, but should be placed where it could never be closed by mistake. If it were secured by a wire when open, the danger of closing accidentally would be eliminated and the wire could be easily broken if necessary to close the valve.

HOW TO CONSTRUCT A CEMENT WATER TROUGH.

Cement water troughs are good for long service as they will stand any amount of freezing without cracking. A correspondent of the Ohio Farmer tells hows to construct one:

Side View of Cement Trough.

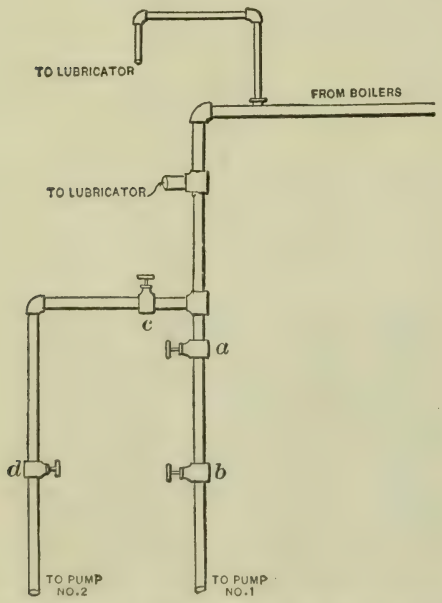
Excavate to the depth of 18 inches a place somewhat larger than the trough is to be; fill the cavity with broken stone, pounding it down until each piece is firmly embedded, pour thin cement over it until the crevices are full and smooth over the top. On top

of this construct a box exactly the shape the trough is to be, having the inside of the box perfectly smooth, with all cleats, braces, etc., on the outside. Make a similar box five or six inches smaller, having the smooth surface on the outside in this case. Place the small box inside of the larger one, brace and make solid and fill the space between the walls of the two with a cement made of one part cement to two of sand. Mix in dry state and but a bushel or two at a time. Wet just enough so that when it is shoveled into the mould and tamped down but a little water will rise to the top. After the cement has set for a time knock off the moulds.

It should harden very slowly. Keep full of water and sprinkle the outside of it. Such a trough costs about the same as a galvanized iron trough.

ONE LUBRICATOR FOR TWO PUMPS.

A correspondent of Power tells how he made one lubricator serve two boiler pumps, using one pump at a time and changing to the other in case the first gave out.



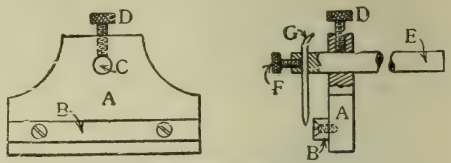
Connecting one Lubricator for Use with Two Pumps

Referring to the diagram the arrangement is as follows: If using pump No. 1, close valve C, then D, open A wide and regulate the pump by valve B. If No. 2 is used, close valve A, then B, open C, and regulate by D.

A MARKING GAUGE.

The marking gauge described here is useful for marking off sheet brass, copper, etc., where the material is of fair length, or the distance from the edge is out of range for use of jenneys, says a correspondent of the Model Engineer and Electrician.

It consists of a block of mild steel (or



A Marking Guage

iron) (A), about ⅜ inch thickness. At about ¼ inch from the bottom edge is fastened a piece of ¼ square steel (B) by means of two screws countersunk flush, and at about ½ inch from the top is drilled a ¼-inch hole (C) to take a length of ¼-inch round steel (E), which should be a sliding fit. Another hole is drilled and tapped in the top of block to take the knurled screw (D) which is to hold tight the steel rod (E). At one end of E a hole is drilled to take a scriber (G), which may be made from a good-sized knitting-needle. Another hole is drilled and tapped to take the knurled screw (F), which is to hold tight the scriber. To use the block, the bar B must rest on the edge of the material to be marked, and the scriber and rod E adjusted.

HOW TO CUT GLASS JARS.

Fill the jar with lard-oil to the point where it is to be cut; heat an iron rod red-hot and plunge it into the oil. Because of the unequal expansion the jar will crack all the way around at the surface of the oil and the top may be lifted off.

TO TOUGHEN PLASTER CASTS.

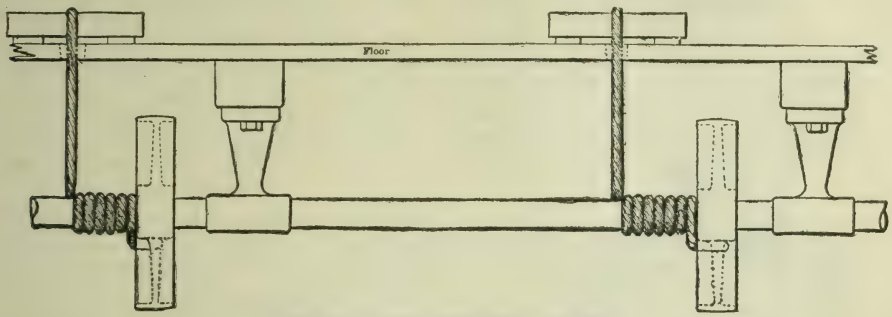
To toughen plaster casts immerse them till well saturated in a hot solution of glue. When treated in this manner a nail can be driven into them and not crack them.

The southern pine forests, from which is obtained the wood so much in demand for building and interior finish, cover an area 2,000 miles long, average 200 miles wide and embrace an area of more than 250,000,000 acres.

AN INGENIOUS HOIST.

The lowering, adjusting and raising of a pulley shaft 150 feet long having many pulleys from 2 to 5 feet in diameter, in a short time without blocks or tackle was the proposition to be met and a correspondent of the American Machinist tells how he dealt with it.

The shaft was, in places, 3 inches in diameter and at others, 4 inches. The



Lowering a Heavy Shaft at Short Notice.

3-inch places were wrapped until as large as the 4-inch. Six lengths of rope 1¼ inches in diameter were used, fastening one end of each piece to an arm of a pulley, the ropes being as nearly equidistant as the pulleys on the shaft would permit. Enough of each rope to reach from the shaft to the floor was then wrapped around the shaft and the other end passed straight up through a hole in the floor above and there secured to a piece of timber. The caps to the hanger boxes were then removed and the shaft was rotated by the rims of six pulleys, a man at each pulley, and in a direction calculated to lift the shaft out of the boxes, when two other men, by means of levers, swung it clear of them. Then the pulley reins were rotated so as to unwind the rope on the shaft and thus it was lowered. The method of raising was simply a reversal of that of lowering.

HOW TO FIREPROOF WOOD.

Wooden buildings or wooden parts of any structure can be made fireproof by a very simple method and at small cost.

Add enough water to a quantity of fresh quicklime to make it of the consistency of cream. Stir well and add two pounds of alum, 24 ounces of commercial potash and one pound of common salt. Mix thoroughly and apply while hot after the manner of applying paint. Pure white effect can be obtained by adding a couple of handfuls of plaster of Paris, or shades ranging from light gray to black may be had by adding lampblack, the amount varying with the shade desired.

Two coats of this mixture will keep wood fireproof for a long while and if the building should be subjected to flames for a time it will not blaze, but merely char. The mixture, with the addition of a few handfuls of white sand to every gallon of liquid, makes an excellent preservative for brick or stone.

TO PREVENT TARNISH ON SILVER.

Brush alcohol in which a little collodion has been dissolved over silver ware to keep it from tarnishing. The thin invisible coating the solution leaves can readily be removed by dipping the article in hot water.

REMOVING RUST.

To remove rust from metal, cover the metal with sweet oil, rubbing it in well, let stand 48 hours. With a piece of cotton wool apply oil freely, then rub well with powdered unslaked lime.

REMEDY FOR BURNS.

A saturated solution of Epsom salts is an excellent remedy for burns. Apply as soon as possible and keep wet constantly until pain ceases.

Among the disputed questions that never will be settled are: Whether a long screw driver is better than a short one of the same family; whether water wheels run faster at night than at day; the best way to harden steel; which side of the belt should run next the pulley; the proper speed of line shafts; the right way to lace belts.

HOW TO BUILD A CIDER MILL AND PRESS.

A correspondent of The Blacksmith and Wheelwright tells how to build a cider mill. We give the instructions here:

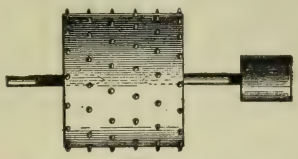


Fig. 1.

Fig. 1 shows the grinder—a black gum log—20 inches in diameter, 18 inches long. Into this drive spikes as shown, allowing them to stick up about ¼ inch. A rod is

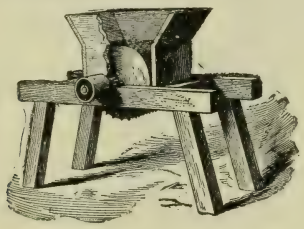


Fig. 2.

run through the log, and a pulley fitted on one end. Then build a frame as shown in Fig. 2, and your mill is ready for business.

Fig. 3 shows a cider press built of 10 by 12-inch timber, 8 feet long. Distance from post to post is 4 feet; mortises, 6 by 10 inches; pin-holes, 1 inch. Use a 3-inch iron screw, 5 feet long, operated by a 6-foot pinch bar.

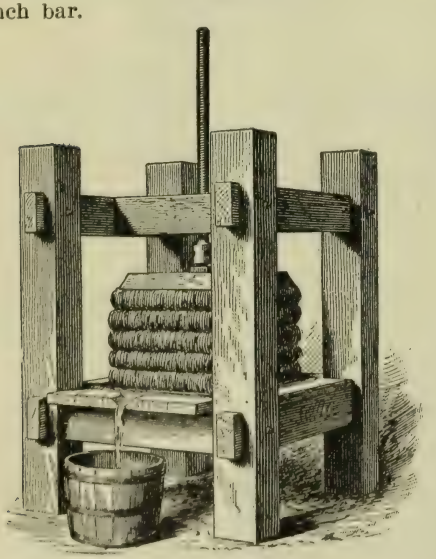


Fig.. 3

COMBINATION ANVIL AND STRAIGHT-EDGE.

An anvil which will serve as a straight-edge as well as an anvil was contrived by a correspondent of American Machinist. It is placed so that its angle is in line with the operator's eye, for this purpose, and

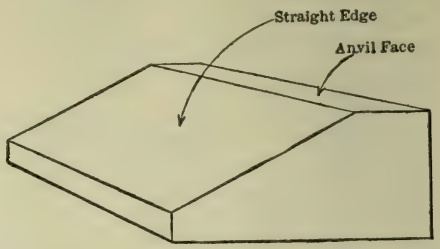


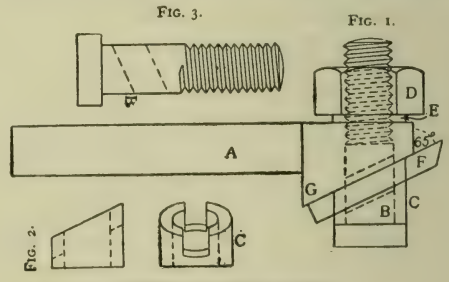
Diagram of Anvil.

should be set on a white paper to get a light background, so as to see more clearly between the face of the anvil and the forging while straightening the latter. For straightening badly bent and twisted small forgings it will be found most convenient.

A HANDY TOOL-HOLDER.

A handy tool-holder which is easy to make and inexpensive is here shown in detail.

The body of the toolholder (A) is cut from an old bicycle crank (axle end, of course), and is cut off at an angle of 65 degrees through boss at section, steel being



Details of a Tool-Holder.

used for cutters (self-hardening). The body of holder at G (Fig. 1) beds against slide-rest, preventing spring of cutter. Perfect adjustment is provided by pushing cutter up or down, as may be required.

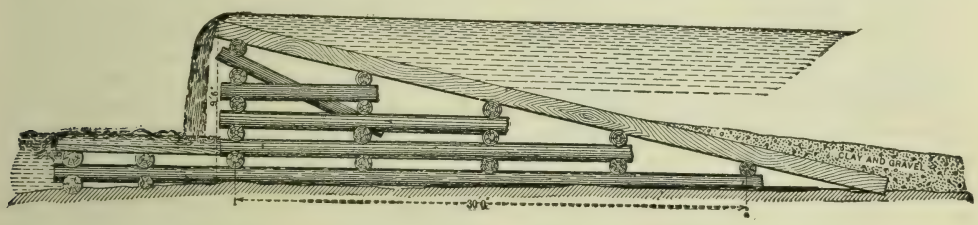
At the present rate of output England's coal supply will last but 371 years. The increasing use of gas and electricity for driving many mechanical mechanisms, however, it is believed will greatly economize the consumption of coal in the future.

HOW TO BUILD A SMALL DAM.

If you live near a small creek, or stream and enjoy boating, swimming, and fishing, but have no place suitable for these sports, why don't you build a wooden dam and make a place for yourself? A club of boys, two or three grown persons, or even a party of girls could pool funds and construct such a dam and create a source of pleasure for many summers and winters after. Boys or men could do their own work.

For such a purpose a crib dam is the construction best adapted to every phase of the case, as it can be built on any kind of a bed, can be of either plank or logs and in a locality where there is much timber land the expense will not be great.

the stream so deep that the logs when laid in them just show. Use logs or plank from 6 by 6 inches to 10 by 10 inches. Logs in the foundation course should be placed from 6 to 8 feet apart and extend deeply into the banks at either hand. If the stream is wide, splice two or more logs together. The second course of logs is placed at right angles to the first, or lengthwise the stream, and an apron is formed between the two foundation logs farthest down stream by placing planks between the logs of the second course and letting them project under the third course, which begins back about 8 feet. From here on the dam proper is built up of the crib-work as high as need be. Use tapering logs for the lengthwise course, letting their tapering ends point up-



Cross Section of Crib-Work Dam

Every locality has its individual conditions which must be considered, and among these are, the depth and width of the stream, its bed, the volume of water, and its velocity. In general the points to be remembered are: The dam must be securely fastened to the bed of the river so that the water cannot undermine it; must have abutments at the banks, or be built into the bank to such a distance that the water cannot work a channel for itself there; must be so solid that it cannot be overturned or shoved aside by the pressure of the water; where the river bed is soft, must have an apron so that the falling water cannot create a cavity into which the dam could be engulfed; must have a surface impervious to water.

If the stream has a rock bottom, it has a natural apron, but the foundation logs must be anchored to the rock. Drill holes in the rocks at places where the logs belong, split the anchor bolts up for five or six inches from the bottom and insert a wedge. Run the bolts through the logs into the holes drilled in the rock. When the bolts are driven in, the wedges expand them and they are thus secured in place. If the bed is of soil or gravel, dig trenches across stream. This gives the upstream side of the dam a slant. The pockets of the crib-work should have vertical sides and may be filled in with stones, brushwood, gravel and some clay. Gravel, however, is best, as the wooden dam is less liable to rot where it is used. Wherever logs cross, flatten them and bolt together by means of drift bolts ¾ by ¾ inches. Square bolts hold best.

For the cover of the dam use 4 by 12 planks, joined so as to be watertight, projecting a little above the crib-work at the top and extending into the bed of the stream at the bottom. Over this put a layer of gravel. In time a layer of silt will be deposited by the stream.

An outlet for the water should be left until the last thing and then closed as rapidly and closely as possible, being careful not to leave this spot weak.

In calculating the speed of pulleys, when the diameter and driven are given, in order to find the number of revolutions, multiply the diameter of the driver by the number of its revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions of the driven.

SOME TYPES OF OIL BURNERS.

We here show three methods of arranging oil burners and a method of attaching them. A correspondent of Power says that

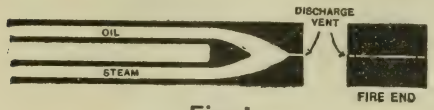


Fig. 1

ONE TYPE OF OIL BURNER.

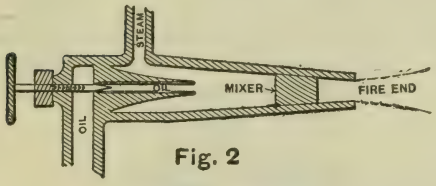


Fig. 2

ANOTHER BURNER.

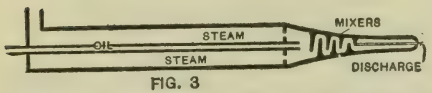


FIG. 3

ANOTHER ARRANGEMENT OF OIL BURNER.

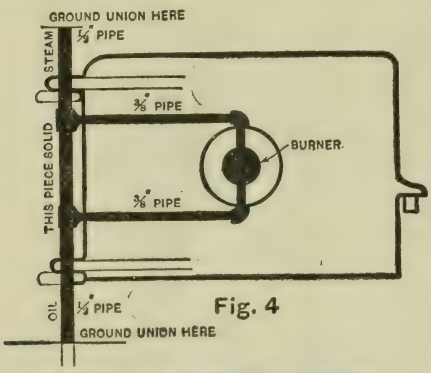


Fig. 4

METHOD OF ATTACHING BURNERS.

Fig. 2 attached as shown in Fig. 4 works beautifully, overcoming many difficulties met with in using other burners.

HOW TO MAKE A TRIP HAMMER.

Take two pieces of wood 8 by 8 inches by 4 feet; lay them eight inches apart and bolt another piece, 8 by 8 inches by 3 feet between them at the back end for an upright. Bolt a piece of 8 by 8 inches by 1 foot long between them at the front as a base for the anvil stand. Take a piece of iron 1½ by 1½ by 2½ feet long, weld a heavy plate on one end of this and bolt it fast to the base. Bore a hole in the upper end and square it into a 1-inch hole. Make an anvil die of tool steel with shank to fit this hole in the stand; drill a small hole through the stand and shank and drive in an iron pin as a key to hold the die.

Make two straps of new wagon tire; bolt to back upright on each side with a ¾-inch hole through the ends for a bolt to fasten hammer arm to. This latter bolt to a tee of the same material, turning the end of the cross tee to fit between the short pieces on the upright and fastening with a ¾-inch bolt. The arm may be made from the large part of a buggy tongue, and the hammer out of a sledge, swelling the eye about as large again. Cut off about one-half the large end and dress up, using the pene for the face of hammer after dressing this up also to suit the work. Brace it both ways solidly. A crank shaft of an old mowing machine may be used for a crank shaft and also the pitman rod for driving the hammer. Make a loop or strap out of wagon tire also to fit over the arm extending above and below about 10 inches, and put in coil springs there to take off the solid blow from the arms and hammer and also to throw the hammer up as a support to the pitman. Screw this pitman into the lower end of the loop under the arm and place a clamp on each side of the loop on the arm, to hold springs and loop in place. By moving the clamp and loop backward and forward the stroke can be regulated.

Next put a crank shaft in its old boxings about one-third way from back end of the base of hammer, and put a pulley wheel on outside end for belt to run in. The belt tightener, of course, can be fastened to the base or back upright to work with trip, which can be made of anything handy that will stand the pull on the belt tightener. It may be fastened to a separate post which is right by the hammer, to which fasten a countershaft, if the engine runs opposite to the way the hammer is to be turned; put in a short countershaft and then run a loose belt from it to the hammer. It gives a steadier belt by making it shorter, as six or eight feet of belting running loose from the line shaft to the hammer will flop, unless it is wide and heavy.

A correspondent of the American Blacksmith says the hammer will cost about $30 and that he has sharpened plows in 22 minutes and welded 1¼-inch axle stubs after taking first heat with hand hammer on such an one.

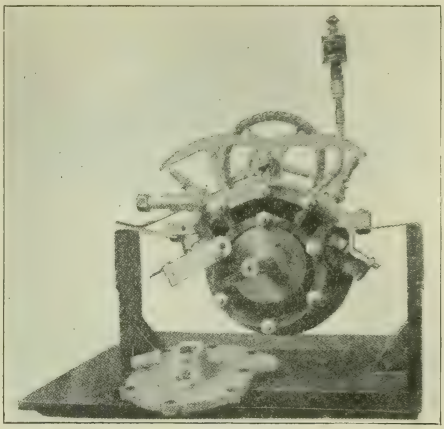
ROTARY GASOLINE ENGINE.

A 10-horsepower rotary gas engine, built on the model exhibited by Otto Konigslow at the March automobile exhibit in Cleveland, Ohio, is soon to be tried in an automobile. The Automobile describes the invention as follows:

"The stationary part of the engine is a cylindrical casting 8 inches in diameter and 4½ inches wide, outside dimensions. Immediately above and integral with this, as seen from left to right in the engraving, are the admission, compression and exhaust chambers. Valveless ports lead from the admission and exhaust chambers to the cylinder. A valve connects the admission and compression chambers, and another the compression and exhaust chambers. The main admission and exhaust valves may be seen at the top of the casting, on the left and right respectively. The operating devices for the valves, also shown at the top, are controlled by cams on a time shaft geared to the main shaft by a chain and sprockets, its time of revolution being one-third that of the main shaft.

"The rotary part consists of a cylindrical casting, mounted on a shaft and set eccentrically with respect to the stationary cylinder so as to be tangent to it at the top and to leave a considerable clearance space between the two at the bottom. The rotating cylinder carries a single blade, forced outward by means of a spring so that its outer edge is always in contact with the inner surface of the enclosing cylinder.

"The operation of the engine is as follows: As the blade passes the port of the admission chamber (the direction of rotation being left-handed), the intake valve opens and the charge is drawn in by suction for an entire revolution. At the beginning of the second revolution, just before the blade again passes the part, the admission valve closes and the charge (now being in front of the blade) is forced through the exhaust chamber, where compression takes place during the entire revolution. At the beginning of the third revolution, just after the blade has passed the port between the admission chamber and the main cylinder, the valve leading from the compression chamber to the admission chamber is opened, so that the compressed gas is allowed to pass into the cylinder. At this instant the gas is exploded by means of an ordinary sparking device located in the compression chamber and, impinging upon the sliding blade, rotates the shaft. During the next revolution, which corresponds with the one first described, the exploded charge is forced in front of the blade out through the exhaust valve to the air, a fresh charge being drawn in behind the blade at the same time for a new cycle of operations.



Rotary Gasoline Explosive Engine.

"The speed is controlled by varying the amount of charge and changing the time of ignition. At a speed of 1,600 revolutions per minute, there is so little vibration that holding-down bolts are unnecessary. This feature, together with its compactness, are the two qualities which recommend it most strongly for automobile service."

The engine is to be cooled by water circulation.

ELECTRIC TRAP TO KILL RATS.

A clerk in Rochester, N. Y., used electricity to rid a warehouse of rats. In one corner he placed a flat piece of copper connected by a wire to the incandescent light circuit. On this copper plate he placed a tempting bit of cheese. Another copper plate, connected with the return wire of the circuit, was placed near, but not touching, the first plate. Rats, trying to secure the cheese, came in contact with both plates at the same time, thus completing the circuit, and were instantly killed.

PREVENTING RUST ON STEEL.

To preserve steel articles from rust, place a lump of freshly-burnt lime in the drawer or case in which they are kept. The lime will absorb a great deal of moisture.

Temporary Camps and How to Build Them

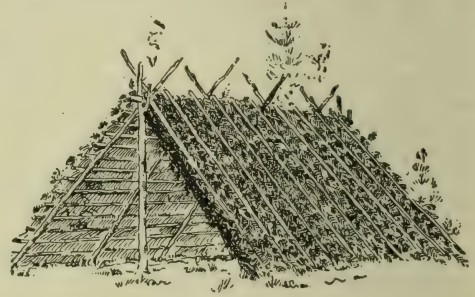
For a short camping excursion, or for use while the permanent camp is being built, nothing is more novel and delightful than the temporary camp built of the materials ever ready in the woods.

The Indian Camp

The simplest form of all perhaps is the Indian camp. To build this, cut an evergreen tree nearly through about five feet above the base of the trunk, so that when the top falls the butt will still be attached to the stump. Hollow out the under side of the treetop by removing boughs and branches. Use the trunk of the fallen part as a ridge pole and bank boughs and branches from it to the ground on either side. The shelter thus formed will be very comfortable, but there are other kinds better calculated to protect from heavy rainstorms. A wigwam sheds rain well because its sides are so steep. Set up three long poles in the form of a pyramid and tie their tops together. Fill the open spaces with poles set at the same slant about one foot apart at the ground and fastened at the top as before. Thatch the outside closely with branches and brush.

There are several ways to build a brush camp, but they all have many similar points. The ridge pole for such a camp (about 8 feet long) may be placed between two trees at a height of about 6 feet, or between two crotched poles set firmly in the ground for the purpose. Long branches may be used to form the sides, but the best method is to lay straight poles on slant from the ridgepole to the ground, about eight inches apart. Begin at the bottom and thatch the sides to the top to a depth of about one foot with hemlock or cedar boughs, laying them with the feather side down; by means of poles weight down the thatch. Such a shelter carefully made will withstand heavy rains.

Another camp in high favor among campers for temporary shelter is the lean-to; this may be an open lean-to—that is,. without ends—or closed as desired and may be



The Brush Camp

thatched with either bark or brush. Select two crotched poles about 7 feet long and set in the ground. Lay another pole across these, with its ends resting in the crotches of the other poles. From this pole slant three other poles to the ground. Push the ends of them well into the earth and fasten securely by means of crotched sticks placed over them and driven into the ground. Across these last three poles lay cross sticks, on which pile brush and weight it down with other poles. Build up the sides in the same way. Where bark is used to thatch the lean-to the top side of the rafters should be flattened so the bark can be nailed

The Wigwam

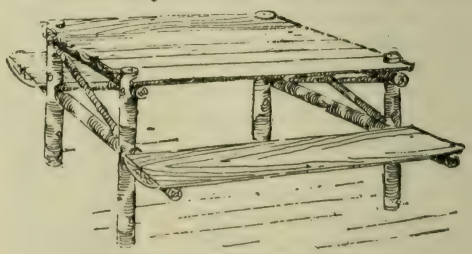
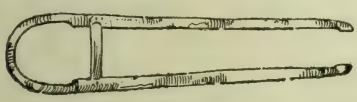


Table and Chairs Combined

to them. Bark may also be used to thatch the wigwam, laying it in overlapping courses, beginning at the bottom, and securing it by means of cord.

To remove bark from trees, cut two circles six feet apart completely around the tree and join the cuts thus made by a vertical cut and pry away the bark by means of an axe. It is most readily removed in the early summer. Lay the bark on the ground to dry for a few days, weighting it down with stones, after which it is ready for use.

Hemlock, spruce or cedar boughs, having all large boughs removed so that only fine branches are left, piled to a depth of two feet, and with the blankets or sleeping bag on these, make the best bed for the temporary shelter. Another form of bed can be made by sewing deep hems in each side of a piece of heavy duck canvas about 40



Tongs

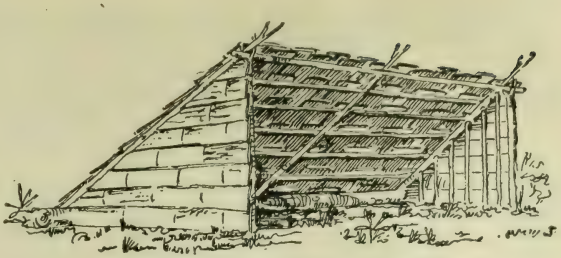
inches wide and 6 feet long. Set four forked poles in the ground, run poles 7 feet long and 2 inches in diameter through the hems of the canvas and set up on the forked poles so it is about a foot above the ground.

In selecting a site for a camp always remember that above everything else fresh water within easy reach is essential. Shade for the hottest part of the day should be considered also. Other considerations vary

Broom of Hemlock Twigs

with the party, the duration of the outing, the country surrounding, etc.

To make a crane set two green sticks 2 inches thick and 3 feet long into the ground a foot from either end of the fire. Split the top ends with an axe and provide another stick as a support. A pair of tongs may be made from a piece of tough green wood, which should be 1½ inches in diameter, 3 feet long and of some wood, such as elm, or hickory, which will bend easily. Cut it half way, a distance of one foot in the center, heat the center over a bed of coals until it will bend together without breaking, whittle



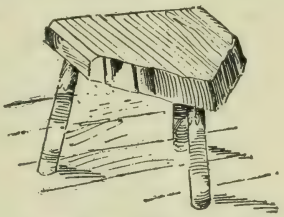
A Closed Lean-to, Thatched with Bark

into shape and fasten the two arms in position by means of a cross-piece. Shape the ends so they will catch hold of anything that has dropped into the fire. A round stick several feet long will serve as a poker.

To make a broom bind hemlock twigs around one end of a stick, using wire or stout cord to hold them in place. Stools are easily made by sawing a 3-inch block from a log a foot thick. Bore three holes in one side of the block, into which drive pegs. A back may be added if desired.

For a rude table set four posts in the ground, nail cross-pieces on top, and cover with slabs cut from soft wood logs. At the right height for seats nail pieces on the legs to extend out on each side and receive slabs which will serve as seats.

Many other articles of use about the temporary camp can be made from such materials as the timber affords. Such things as



Stool Made of a Block

nails, cord, an axe, etc., are indispensable to the camping outfit.

[Next month full details with 17 illustrations "How to Build a Permanent Cabin."]

UNITED STATES OSTRICH FARM.

Ostriches imported from South Africa to Arizona 11 years ago are thriving. At first the birds did not do well, but the last five years have shown a marked difference in them. They are some inches taller than their African ancestors, standing 8 feet high, and weigh 200 pounds. There are now 1,000 birds in the Salt River valley, each yielding about a pound of feathers every eight months.

Modern Telegraphy Necessitates Brain

The Phillips Code for Sending Press Dispatches is as Difficult to Learn as a Foreign Language

Telegraphy is regarded by the general public as a purely mechanical occupation requiring little skill, judgment or intellectuality, and the telegraph operator is considered a tool-like medium whose duty is merely to transfer the thoughts of superior minds from one locality to another. Nothing could be more erroneous, and those who hold such opinions have little knowledge of the real duties required of modern telegraphers. Telegraphers must have quick wits and splendid memories in order to succeed; their work is one of the finest of mental trainings and has often resulted in elevating telegraph operators to high stations in life.

Railroad telegraphy and telegraphy by the Phillips code, as now employed by the Associated Press, require a high degree of intelligence. The modern telegrapher must be an expert typewriter as well as telegrapher, receiving news matter by ear and typewriting it at the same time. In the Phillips code there are about 2,000 combinations and signs which the operator must have literally at his fingers' tips. This code consists of words and signs which, in themselves, constitute a language nearly as difficult as the Chinese, and which are absolutely unintelligible to any but the expert operator.

Here is a copy of a press message recently sent out by wire:

"T potus, ixs wi km to Kevy his itn to oa sign t agm q Pip qsn."

Written out in full, as the receiver translates it on the typewriter, the message reads:

"The President of the United States, it is said, will communicate to King Edward VII his intention to at once sign the agreement on the Philippine question."

In the Phillips code nearly every letter in the alphabet is employed singly to denote some combination of words, and words are used to represent phrases. Thus "hog" means "in consequence of," "kaw" means "adjourned sine die," and "ck" means "committed suicide." Here are the first sentences of a press dispatch as it was received over the wire. It was sent from Chicago. Leaving out the date line, it runs:

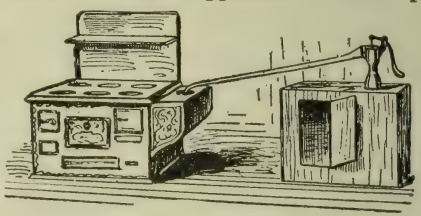
"A dsx fi at 2 oc tsm nry rekd t sto oqd bi ℭx Smith Bros on Sta str. T origin f fi is unkn. Iw fs dgd bi ofc Obien dily bak f ofs q er floor. T flas wr shootg k entrance q alley es t awng hr ws in flas. T fi dpm tru an er, was cld to thr sto on Madison str es wn t engs arvd t flas wr mkg gd hedwa d rear prt f bldg es smoke was isng fm all prts f bldg."

The operator takes this message by ear and writes it off on the typewriter as follows:

"A disastrous fire at 2 o'clock this morning nearly wrecked the store occupied by Smith Bros., on State street. The origin of the fire is unknown. It was first discovered by Officer O'Brien directly back of the office on the lower floor. The flames were shooting out of the entrance on the alley and the awning there was in flames. The fire department, through an error, was called to their store on Madison street, and when the engines arrived the flames were making good headway in the rear part of the building, and smoke was issuing from all parts of the building."

CONVENIENCE FOR HOUSEWIVES.

A small conductor pipe running from the pump or a faucet at the sink to the range reservoir is a simple contrivance which any housewife would appreciate. The pipe



Filling the Range Reservoir

should be funnel-shaped at the upper end and just large enough to slip over its connection which should be some inches higher than the reservoir. The pipe being small, can be easily stowed away when not in use.

In the Lofoten Islands cod-liver oil is never adulterated in the winter time, because cod is the only fish caught there at that time. Only within the last two years the practice of adulterating cod-liver oil with oils from the livers of cusk, haddock, coal fish and ling has been known. In the summer time these oils are refined and used extensively.

MECHANICS FOR YOUNG AMERICA

HOW TO MAKE A PROPELLING VEHICLE.

Any boy, with a little knack and a few odd tools, can rig up various contrivances which will be a source of pleasure to himself and oftentimes can be sold, to less ingenious boys, for a snug little sum. Any tool a boy can obtain is apt to be of use to him, chisel, bit, jack-knife or hammer.

Figure 1 shows what two boys did with old cycle wheels. They went to some junk shops where the concerns had purchased cast-away bicycles and noticed that there were numerous wheels in very good order that could be selected from among the sets of wheels with broken or bent rims, spokes, burst tires, etc. In fact, the lads had no trouble in getting several sets of bicycle wheels in fit condition for use at 20 cents for each wheel. These wheels were taken to the back-yard shop of the boys where the young fellows had rigged up a shed-like affair and put in a bench. The previous Christmas one of the boys had had a box of tools given him, and these tools included a little hand vise and the required tools for general boy's handiwork.

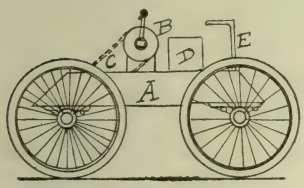


Fig 1

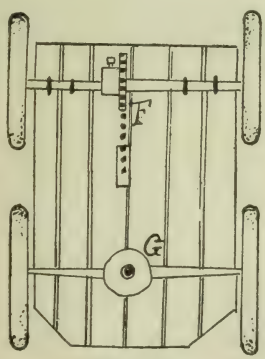


Fig 2

Four of the cycle wheels they used in making the hand-propelled vehicle shown at Fig. 1.

A wooden body, A, made of smooth boards rests upon shafts. Fixed on this body is an upright carrying the cog B. The upright is a piece of wood about 10 inches high and 4 wide, fitted with one of the bearings from the cycle. The regular cycle chain cog is used at B as well as upon the shaft. The regular chain of the cycle is likewise employed, so, when buying the wheels, it is well to select one or more chains with corresponding cogs from the junk heap. The detail of the adjustment of the parts is shown in next views. The letter D signifies the seat which is a box. The steering gear is a bent iron rod, also found in the waste pile of the junk shop, and is bent to right form by heating and bending over on a rock or any solid matter. The steering rod is marked E. It fits into a socket in the shaft of the forward wheels.

Fig. 2 shows the construction of the cart below. The cog is keyed or set-screwed to

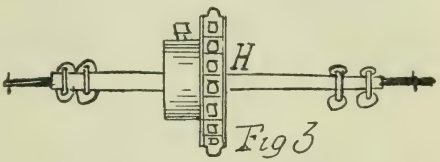


Fig 3

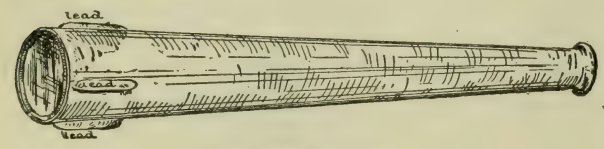
Fig 4

the driving shaft of the wheels with either key or set-screw used in original fastening, as the case may be. The chain is marked F, and there is a slot cut in the floor of the cart to let the chain pass up and through to the cog on the propeling shaft crank. The disk which receives the steering rod is at G. The forward shaft bears only at the center upon a disk of metal, consisting of any circular piece found among the pieces of iron or brass at the junk store. One can get nearly all the mechanical parts in junk establishments that purchase parts of out-of-date or cast-away bicycles. The detail of the driving shaft is shown at Fig. 3. The cog work is at H and this is just as it is taken from the original bicycle shaft. The bearings consist of wires looped around the shaft and inserted into holes bored in metal plates as shown. These plates are screwed to the bottom of the cart. The shaft itself is found in rods or even cast-away metal axles which are commonly found in most any carriage works, cycle shops or junk dealer's. Fig. 4 shows the disk that receives the steering gear. The disk is bored around edges for the securing screws, while the

center is open for the steering rod. When put together, three boys usually ride. One steers and the other two turn the crank. Freight can be carried and some boys do quite an express business in their town with one of the carts like this that they made.

HOW TO MAKE A WATER TELESCOPE.

Before you decide on a place to cast your hook it is best to look into the water to see whether any fish are there. Yes, certainly, you can look into the water and see the fish that are there swimming about, if you have the proper equipment. What you need is a water telescope. This is a device made of wood or metal with one end

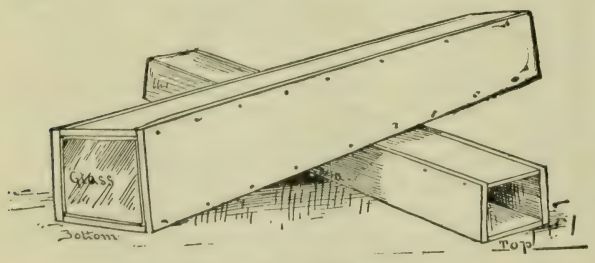


Tin Water Telescope

of glass. When the glass end is submerged, by looking in at the open end, objects in the water are made plainly visible to a considerable depth. In Norway, the fishermen use the water telescope regularly in searching for herring shoals or cod.

All that is necessary to make a wooden water telescope is a long wooden box, a piece of glass for one end and some paint and putty for making the seams watertight. Fix the glass in one end of the box, and leave the other open to look through.

A tin water telescope is more convenient than the wooden one, but more difficult to



Wooden Water Telescope

make. The principal essential for this is a circular piece of glass for the large end. A funnel shaped tin horn will do for the rest. Solder in the glass at the large end and the telescope is made. Sinkers consisting of strips of lead should be soldered on near the bottom to counteract the buoyancy of the air contained in the watertight funnel and helps to submerge the big end. The inside of the funnel should be painted black to prevent the light from being reflected on the bright surface of the tin. If difficulty is found in obtaining a circular piece of glass, the bottom may be made square and square glass used. To picnic parties the water telescope is of great amusement, revealing numerous odd sights in the water which many have never seen before.

HOW TO MAKE PAPER BALLOONS.

Any boy who can make kites can make enough paper balloons for a Fourth of July celebration and can make and sell enough of them to pay for all the necessary materials, which are very few.

Paper balloons may be of any size desired and have as many gores as one wishes in whatever colors one prefers. A very good size is 3 feet in height with 32 gores, each gore being 3 inches wide at the bottom, 8 inches wide at its widest point and 1 inch wide at the top. To make the balloon pear-shaped, the three widths mentioned when added together (3+8+1=12) should be one-third of the height of the balloon.

Procure close-textured tissue paper in any contrasting colors you like; red and white are good. Cut out a pasteboard pattern exactly the shape and size the gores are to be and cut the gores out by it.

Varnish each gore with boiled oil and hang it up on a line to dry, being careful not to let it come in contact with any other gore. When they are perfectly dry put them together by means of gum water, or clear thin paste. To do this gum about one-half inch of a gore and lay one edge of another gore midway across the gummed space and dab down very lightly by means of a clean cloth. In this manner unite all the gores in pairs until there are but 16 parts. Continue to unite them until you have two halves. Join these very carefully, closing the balloon at the top completely. Each time you paste a gore hang the part up until perfectly dry before using it further.

In the bottom of the balloon work a circle of wire 6 inches in diameter and fasten a wire with a piece of sponge strung on it across the circle of wire. A light car or

other light weight may be attached to the wire and will help to steady the balloon as it ascends.

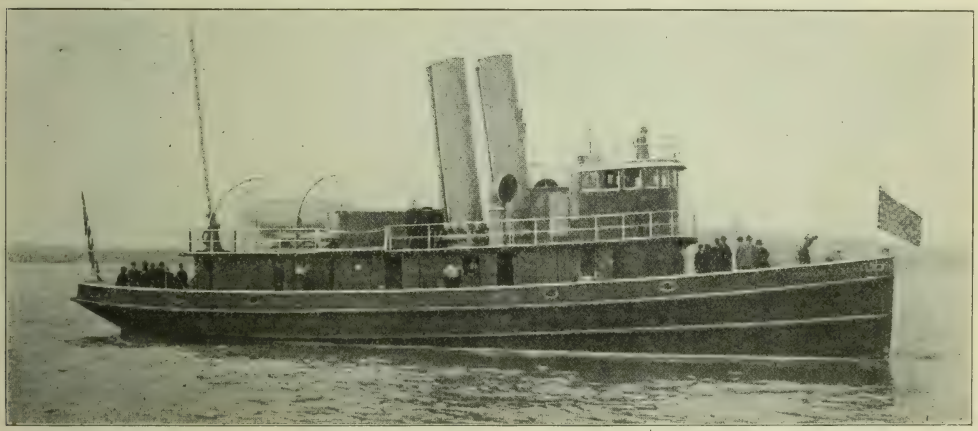
To start the balloon on its ascent immerse the sponge in alcohol, then hold the balloon by the top over a piece of smouldering brown paper until it is sufficiently inflated; ignite the sponge and let the balloon ascend.

NEW YORK HAS TWO NEW $180,000 FIRE BOATS.

New York's fire boat equipment has recently been increased by two $180,000 boats, the "Abraham S. Hewitt" and the "George B. McClellan." Formerly there were five boats in service; now there are seven, but two are laid up for repairs. The "Hewitt" is in service at Brooklyn.

U. S. GOVERNMENT TO CONTROL WIRELESS TELEGRAPH STATIONS.

The United States Government has laid its restraining hand on the erection and operation of wireless telegraph stations for trans-ocean messages, at stations within our national domain. Marconi mastered the mysteries of space telegraphy, but will have to secure consent of the Federal authorities before proceeding farther. The necessity of government control of so powerful a factor in time of war is self-evident. Ocean cables can only be landed on any shore by the express consent of that country, and the same rule will now be applied to the new wireless system. Unless Marconi can secure the coveted consent he will be required to take down and remove all his stations in this country.



The "George B. McClellan," New York's New Fire Boat

The "McClellan" has a length over all of 116 feet, perpendicular 109 feet, breadth 25 feet, depth 13 feet 8 inches. It is provided with two cylinder compound engines, horsepower cylinders 17 inches in diameter, low pressure cylinders 34 inches, stroke 24 inches, two single and Scotch boilers 10-9 inches diameter; two vertical duplex flywheel pumps, two 7-inch steam cylinders, two 10-inch pumps, 11-inch stroke; one pump of same design with two 9-inch steam cylinders and two 5½-inch pumps, 8-inch stroke. There are three monitor nozzles on the boat. Its capacity is 7,000 gallons a minute.

Earn a trip to the World's Fair. Write Popular Mechanics for particulars.

FERRIS WHEEL MOVES TO ST. LOUIS.

The great Ferris wheel, which was the mechanical feature of the Midway at the Chicago World's Fair, has been taken down and shipped to St. Louis. The material filled 120 cars, the large shaft alone weighing 76 tons. The expense of simply taking down the wheel was $40,000.

A boy in Waterville, Ohio, who expects to graduate from high school this year, is finishing his course over the telephone. As a result of an injury one of his legs is in a plaster cast so that he cannot attend his classes. Every day he is carried to the telephone and recites his lessons in that manner.

DAILY PAPERS PRINTED IN MID-OCEAN.

Wireless Telegraph Specials to be Issued Each Day With the News of the World

The worn-out business and professional man accustomed to seek retreat from care and worry in an ocean voyage will now have to find some other means of escape. Within a few weeks the shrill cry of the newsboy as he makes the rounds of cabins and decks, will announce another day as he calls out "mornin' paper." One more feature of city life will be added to the long list already provided by the ocean greyhounds, and the new occupation of "ship's editor" will be created.

Wireless telegraphy is to be utilized for publishing a daily newspaper on board Atlantic steamers. The paper will contain the same news that Chicago and New York citizens will read on the downtown trip of mornings, having full benefit of the Associated Press telegraphic reports and being of standard size. Moreover, German, English, American and ships of other countries will publish exactly the same news in the various languages. The editorial rooms will be located ashore and new matter, changes in advertisements, etc., be transmitted by wireless telegraphy.

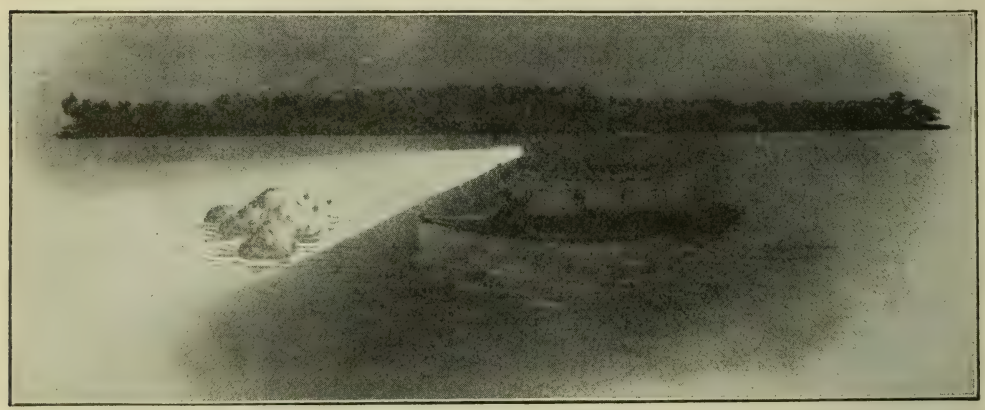
It is said that the project involves figures which will make it profitable for those backing it; that there are from 20,000 to 30,000 people on the seas at times and that space in such a paper will be worth while to advertisers.

The German budget bill for 1904 calls for $64,600,000 for naval purposes.

SEARCHLIGHT FOR LAUNCHES.

The boating season is at hand and to a larger extent than ever before are people buying and using motor boats of various kinds. For running at night a strong headlight is a prime necessity; not only to avoid running into obstructions, but to prevent being run into by other craft.

Experiments recently made by engineers on German railroads as to which light had the most penetrating powers during a fog show that acetylene proved itself to be the best. A test was made in a dense fog, three locomotives being stationed in the railroad yards, the headlights of which were supplied, one with an electric arc, one with the usual oil lamp and the third with acetylene of three-fourth foot flame. At a distance of 75 feet the electric arc light was entirely obscured; at 100 feet the oil light was lost from sight, while at this distance the acetylene light showed hardly perceptible diminution, and was visible at 200, 300, 400 and finally 500 feet from the locomotive, at which distance it was still in sight, although faint. These tests and measurements were made by careful men and can be considered trustworthy.



Acetylene Searchlight for Launches.

Including Alaska, Hawaii, Porto Rico and the Philippine Islands, the gross area of the United States (land and water surface) is 3,622,933 square miles.

All colors, save drabs and aniline browns, can be matched by the arc light, provided the arc is clear and open and the carbon pencils free from sodium and calcium.

LIMERICKS.

A musician there was—Paderewski—
Who never would drink nor would chewski;
As a matinee blade,
He made Hackett afraid,
And quite broke the heart of John Drewski.

There was a fair maiden of Siam,
Who said to her lover, "O Priam,
You may kiss me, of course,
But you've got to use force—
And God knows you are stronger than I am!"

There was a young lady of Skye,
With a shape like a capital "I!"
She said, "It's too bad!
But then I can pad"—
Which shows you that figures can lie.

Young Henry went out for to shoot,
With a gun and a high rubber boot;
He shot an old goat,
A guide and a shoat—
But he's best when he's shooting the chute.

There was an old lady of Threedle,
Who sat down in church on a needle,
Tho' deeply embedded,
'Twas, luckily, threaded,
And quickly pulled out by the beadle.

LONGEST CABLEWAY IN THE WORLD.

A cableway starting from a point 3,430 feet above sea-level and extending 22 miles to a point 14,933 feet above sea-level (1,300 feet higher than the summit of the Jungfrau) is to be built over the Andes. The engine station will be located at the highest altitude of any in the world, and below the cableway will be a rugged chain of rocks, yawning chasms 300 feet wide and 600 feet deep and in some places it will be necessary to have iron towers 130 feet high for supports. The cable rope will be 87 miles long.

For the construction of the cableway all the materials required will have to be carried to the spot by pack mules. By despatching a bucket load of 1,100 pounds of ore every 45 seconds the line will be able to handle 44 tons an hour.

SEE SPECIAL OFFER
ELSEWHERE OF OUR NEW BOOK
"Popular Mechanics Shop Notes"
JUST OUT

$1,000 CASH
For Ideas

Can you write a good ad. in prose or poetry? Can you make a good pen or pencil sketch? We are going to pay $1,000 CASH through the Morgan Advertising Agency, Chicago, in monthly awards for best ideas. Costs nothing to try. Send postal for information.

THE NUTRIOLA CO.
BA, 142-148 W. Madison Street, Chicago, Ill.

Are you
"A BROTHER TO THE OX?"

Are you getting a living by WORK alone? If so, there is something BETTER for YOU. This little ad. may be the KEY to open the golden door to wealth and enjoyment. Many readers of Popular Mechanics have joined us. Why not YOU? It will cost you but 1 cent to investigate. We will send you our 20-page illustrated book

"A GUIDE TO FULL POCKETS"

FREE. DON'T SEND US A CENT. WE PAY POSTAGE. It is our money against your time. You will learn how one man in Belfast, Maine, earned $330,000 for small shareholders in 18 months with only $1.50 capital. Paid it to them in CASH, making them wealthy. Reads like a fairy tale but every bit TRUE. IT'S HISTORY. You can become a PARTNER with this man by investing $1 or more. REFERENCES: Mayors, Bankers, Church, Public and Fraternal Officials, Business Men, etc., all you want. If you won't spend a CENT for a postal card to investigate what we offer, why just plod on. It will be evident YOUR neck is intended for the YOKE and you wouldn't feel happy with a crown. If this was a SCHEME or FAKE we couldn't show the best references in the world and PROVE everything that we state to be true. You know that. Don't forget the book is FREE. THE NUTRIOLA CO., BA., 142-148 W. Madison Street, Chicago, Ill.

BOYS
We are giving away Base-ball outfits, Boxing Gloves, Punching Bags, Footballs, etc.

Send address for full particulars to
POPULAR MECHANICS,
602 Journal Bldg. Chicago, Ill.

GOODRICH LINE STEAMERS

YOUR CHANCE FOR SUMMER ENJOYMENT

3 and 4 DAYS LAKE TRIP : : $13
Chicago to Menominee, Mich., and Ret. Including Berth and Meals.

5 DAYS LAKE TRIP : : : : : $20
Chicago to Mackinac Island and Return Including Berth and Meals.

MUSKEGON OR GRAND HAVEN
And Return From Chicago $2.75

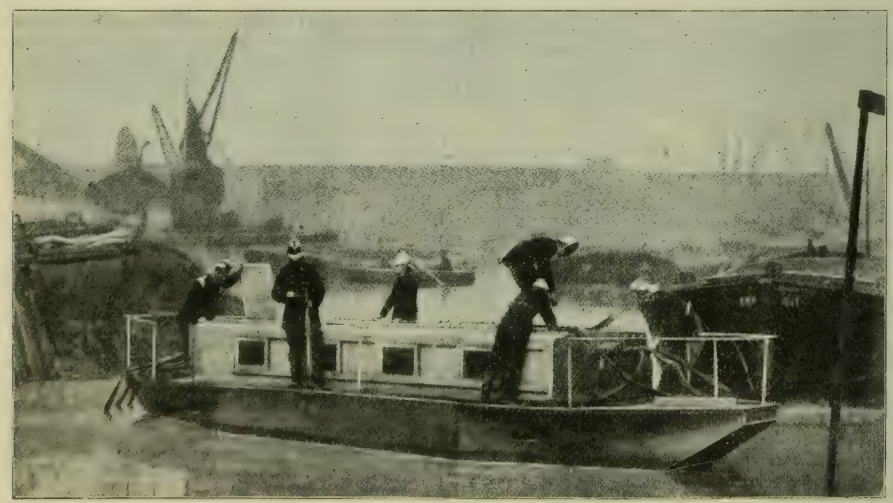
MILWAUKEE
And Return From Chicago $1.50

Write about it
R. C. DAVIS, G. P. A.
Chicago, Ill.

A scientific paradox affording an endless source of entertainment to all, regardless of age or sex. Absolutely the greatest novelty to be had. THE WIZARD TOP is constructed on accurate scientific principles, is TWO TOPS, one within the other, made of STEEL, handsomely finished in NICKEL. Absolutely new method of producing rotary movement. No springs, no tedious winding. But 3 seconds required by a child to produce 20,000 revolutions per minute. It WHISTLES and spins 8 minutes. Over 50 REGULAR TRICKS already credited to it. Can be handled and placed at any angle, where it maintains its equilibrium, contrary to known laws of gravitation, while running at high speed. Complete outfit, IMPROVED WHISTLING TOP, Pedestal, Swing, Ring, Wire Walking Attachment, Cord and Illustrated Directions, sent postpaid for 30c., or 4 Complete outfits for $1.00, postpaid. Satisfaction guaranteed. For sale at all dealers. WIZARD NOVELTY CO., Inc., 1013 Filbert St., Phila., Pa., U. S. A.

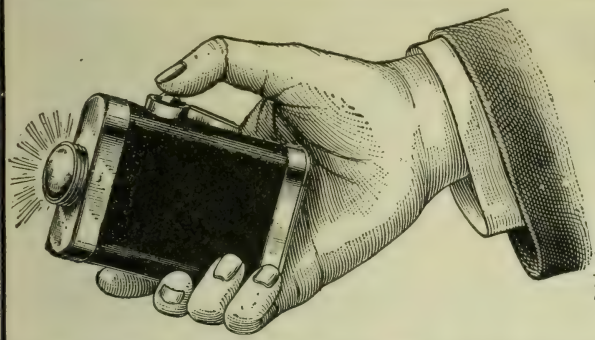
Fireboat Propelled by Spouting Water

A new fire float for the protection of a large biscuit works located on the Reading Canal, England, is propelled by means of jets either ahead or astern and is steered by shutting them off on either side, by means of levers on deck. Two pumps, taking suction from both or either side of the boat, and driven by two 30-horsepower, 4-cylinder petrol motors, deliver into a main pipe running fore and aft; from this main pipe there are six hose connections, so that six streams can be thrown at once. The little float has a steel hull 32 feet long, with a beam 9 feet 6 inches; draws 2 feet 6 inches when fully loaded; has 4 feet 6 inches head room, being built to pass under bridges. Her reels carry 1,000 feet of hose; the capacity of her pumps is 600 gallons per minute and she can travel at the rate of five to six miles an hour.



Water-Propelling Fireboat

Your boy, doubtless, has already become interested in the department of Popular Mechanics entitled "Mechanics for Young America." It is good for him if he has. Not so much because of the money value of the things he learns to make, but because they teach him what his efforts can achieve. Such knowledge in after years enables men to dig canals dividing continents, to build great railroads, to tunnel mountains and to construct great steel skyscrapers in our modern cities. It is a kind of knowledge worth cultivating in the young American brain; for just as mechanical equipment decides the fortunes of war, so does mechanical knowledge in this age of mechanics measure the power of nations, the greatness of cities and the competency of men.



THE RELIABLE

ELECTRIC VEST POCKET LIGHT

If you wish to find a house number at night; if you wish to find an article you have dropped; if you wish to avoid dangerous places in dark streets, just "press the button" and you have an instant, brilliant light. Will give eight thousand flashes, or burn three months with right usage. Inexpensive to buy and to operate!! Invaluable to physicians, or miners and gasfitters who go in dark places where any other form of light is dangerous. Batteries and bulbs easily detached and renewed when required.

$1.50—Complete—$1.50

Write for prices in quantities and complete catalog. Agents wanted

HOWARD ELECTRICAL NOVELTY COMPANY
183 Lake Street, Chicago

A CLOSE SHAVE

That is what we are giving to the price on this Razor Strop. It is not a fancy article with nickel-plated fittings, etc., but all the value is put into the leather.

AN HONEST STROP FOR AN HONEST PRICE.

Sent Postpaid, 50c.

STERLING SUPPLY COMPANY,
56 Fifth Ave. . . . . Chicago, Ill.

SEND US $10.00 TO INVEST FOR YOU IF YOU DARE

We promise you nothing in return, but if you should be put in the way of making $1,000.00 through this original investment, you would be satisfied and would doubtless not hesitate to tell your friends.

GRASP THE OPPORTUNITY IF YOU HAVE THE "NERVE." DON'T WASTE ANY TIME IF YOU WANT TO GET A FRONT SEAT IN THE "BAND WAGON" FOR THE FUTURE.

If you have sent money to people who promised great big returns but gave you nothing. just take a shot where nothing is promised then compare results. We will report at once and will venture the assertion that it will be a great and pleasant surprise to you, and it will reveal a way as plain as A. B. C. for you to keep right on making money. We are on the inside and it is to our interest to have you with us.

We want to reach 100,000 people in sixty days and we have the only practical way in which this can be accomplished and at the same time have all of same interested with us.

We want the right kind of people associated with us, and furthermore, want their entire confidence, and have adopted our own peculiar system of securing both at a small expense.

Only one person in each city (unless over 10.000 inhabitants) allowed this Original Proposition. Consequently, we accept the first reply and reserve the right to return all others.

You have no time to waste, neither have we, so don't waste time writing, as we treat one and all alike, and if you have the "nerve" send us your $10.00, otherwise pass us by. A Business Proposition for business people. If you wish to better your condition, remit at once while the opportunity is yours. Make checks, drafts or money orders payable to M. H. Burt, Mgr., and address,

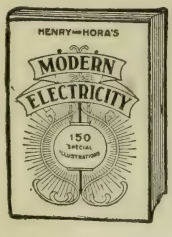
M. H. BURT INVESTMENT COMPANY

Industrial Department, **CHICAGO** 207 Security Bldg.

Greatest Electrical Book

HENRY & HORA'S

Modern Electricity



A new and complete encyclopedia of this great science. Full descriptions of all electrical devices and machines, systems of transmission and distribution—every important branch of electrical science, including X-rays, wireless telegraphy, radium, etc. Devoid of theories and technical phrases. Complete cross index and appendix, 855 pages.

THE PROBLEMS OF ELECTRICITY SOLVED

An invaluable aid to the electrical engineer, workman, apprentice or student.

PRACTICAL : ACCURATE : SCIENTIFIC

Absolutely original matter prepared by expert electrical engineers, never published before.

150 ILLUSTRATIONS

drawn especially for this work.

Silk Cloth Decorative Cover, Silver Stamping, : : : $1.00
Seal Leather, Marbled Edges, Gold Stamping, : : : : 1.50

Laird & Lee's Imprint on Scientific and Mechanical Books Guarantees Reliability.

AT YOUR DEALER'S OR
SENT POSTPAID ON RECEIPT OF PRICE.

LAIRD & LEE, PUBLISHERS, 263-5 Wabash Av. **CHICAGO**

YACHTING TERMS AND THEIR MEANING.

With the yachting season nearly upon us it is time to learn the meaning of yachting terms in common use. Here they are:

ABEAM—At right angles to the ship's side. A wind is abeam when it blows at right angles to the ship's course.

AWASH—Level with the surface of the water.

BACK STAYS—The ropes or stays that help to support the mast, and are attached to the deck aft of the mast.

BAG—Sails are said to bag when they do not set flatly.

BARE POLES—No sails set.

BEAM—The breadth of a vessel at its widest part.

BEAM ENDS—When a vessel lies over so far that her deck is perpendicular to the water.

BEAT—Beating to windward is making way (sailing) against the wind, going in a zig-zag course.

BOW—The forward end of a ship.

COMING ABOUT—"About ship," or tacking, is to put a vessel on the opposite tack from the one it had been sailing.

DRAUGHT—Depth of a boat in water.

FORE AND AFT RIG—Sails and spars lengthwise of vessel; sloops, schooners, etc.

IN IRONS—A ship is said to be in irons when it is head or bow to the wind and will not turn to right or left.

IN THE DOLDRUMS—When a ship is laboring between a calm and a light puff of air.

JIBING—When the course is changed while running before the wind in a fore and aft rigged vessel so as to bring the sails from one side over to the other.

KNOT—A nautical mile—6,087 feet. Applied to speed only. The statute mile is 5,280 feet.

LEECH—The aft edge of a sail.

LEE SIDE—The ship's side away from the wind.

LUFF—To come into the wind so that the sails do not draw. The forward edge of a sail.

MISSING STAYS—Failing in an attempt to tack come about.

OFFING—Away from the land toward the sea.

PEAK—The upper after corner of the mainsail.

PORT—The left side of a ship.

QUARTER—Either side of a ship between the stern and amidships.

REACHING—When the ship is sailing with the wind on the quarter.

REEF—To shorten sail.

RIGGING—Everything that supports the masts or other spars, or that is employed in setting or trimming sails.

RUNNING—When the wind is directly aft, behind, astern.

SAILING OFF THE WIND—When the wind is aft of amidships, the ship is then sailing free.

SAILING ON THE WIND—When the wind is forward of amidships, the ship is then close hauled.

SHAKE OUT A REEF—To loosen that part of the sail that has been previously reefed or tied in.

SQUARE RIG—Sails and spars across the vessel, ships, barks, brigs, etc.

STARBOARD—The right side of a ship.

STERN—The aft end of a ship.

WEATHER SIDE—The ship's side on which the wind is blowing.

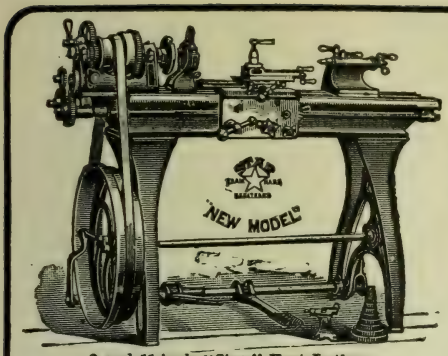
A Good Figure

Is spoiled by stooping shoulders. The best aid to securing an erect figure is

THE RADIUM BRACE

Strong, durable, comfortable. Sizes for men 32 to 42. Price $1.50. Boys 24 to 30, $1.25, postpaid. Send Chest measure. Money refunded if not satisfied. A special pattern for women and misses. Free Catalogue. For sale by all dealers or write

Illinois Suspender Co., 161-C Market St., Chicago



9 and 11-inch "Star" Foot Lathes.
9, 11, 12 and 14-inch "Star" Power Lathes

STAR LATHES Foot and Power...

High-grade screw-cutting engine Lathes, with forged crucible steel hollow spindles, phosphor bronze bearings, gear-driven reversible feeds with strong friction drive in apron, our patented spring nuts which allow quick shifts of change gears, also Draw-in Chuck, Gear-cutting, Milling and Taper Attachments if desired.

Suitable for electrical and repair work, model makers, gunsmiths, technical schools and fine, accurate machine-shop and tool-room service. Ask for COMPLETE DESCRIPTIONS.

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N. Y., U. S. A.

WHY WAVES OF LIGHT DO NOT PASS THROUGH SOLIDS.

Why do X Rays and the Hertz waves pass through solids, while waves of light do not? Light waves will not pass through because the waves are about the same length as the spaces between the atoms in a solid. X Rays will go through because they are so much smaller than these spaces. Hertz waves will go through because they are so much larger than these spaces.

The space between the atoms is, roughly stating, about the hundred-millionth part of an inch; a light wave is about the same distance across, and is many thousand times greater than the distance across an X-Ray wave. Hertz waves may have any size, from a few inches to many miles across.

Imagine these waves to be the ordinary waves of the sea; imagine the solid to be a long row of high stakes at regular intervals apart in this sea, broadside to the waves.

Suppose that the stakes (which represent atoms) are about three feet apart, and there are forty or fifty rows of them for the waves to get through.

(a) Waves of from two to ten feet across will be broken up and almost entirely stopped, and inside the stakes there will be calm. This corresponds to waves of light breaking on a piece of wood—behind the wood it is dark.

(b) Imagine the great breakers of the ocean 80 to 100 feet across to break on the stakes; these waves will pass through almost as if the stakes were not there. Similarly, a wall a foot or two through will have very little effect on the Hertz wave two or three miles across, in fact, less than the thinnest tissue paper will have on the light of the sun.

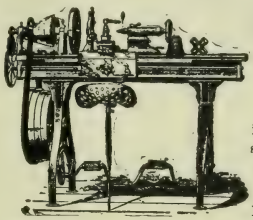
(c) Imagine the spaces between the stakes to be some thousands of feet instead of three feet, our waves of two to ten feet will pass through without any trouble. This corresponds to X Rays passing through the spaces between the atoms. If the barrier of stakes be made more dense, the waves will pass less easily through it; in the same way X Rays pass with more difficulty through heavy dense metals than through light wood.

So solid matter is transparent to the Hertz waves because they are so big; to Röntgen Rays because they are so small.

Electric Motors, 65c., Postpaid

Entirely new design. Send for catalog of novelties and supplies.

Artesian Electric Co. 1059 Columbia St. Chicago



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
109 Ruby St., : : Rockford, Ill.

FOOT and POWER

AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

CHEAP RATES California, Washington Oregon, Colorado. We secure reduced rates on household goods of intending settlers to the above states. Write for rates. Map of California FREE.
TRANS-CONTINENTAL FREIGHT CO., 329½ Dearborn st., Chicago

3 MONTHS FREE

If you are interested in any kind of investment—Oil, Mining, Plantation, Industrial, Lands, Stocks, Bonds, Mortgages, etc., send us your name and address and we will send you The Investor's Review for three months free of charge. A journal of advice for investors. Gives latest and most reliable information concerning new enterprises. Knowledge is power. Great opportunities come and go. Great fakes likewise. Get posted before investing. Write today.

INVESTOR'S REVIEW, 1461 Gaff Bldg., CHICAGO, ILL.

NEW TRIUMPH FOR THE PHONOGRAPH.

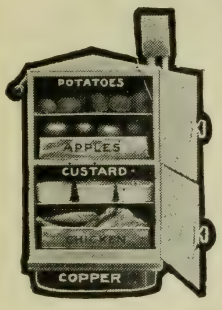
A large audience at Fort Harrison listened to a band concert given over the telephone line by a phonograph and though they were getting the real article. The concert had been arranged for to be given by the Brewery Band at Butte, Mont., but when the time came the telephone line would not work. The manager of the telephone company settled the matter by moving his phonograph up to the telephone and the Fort Harrison audience enjoyed the evening without a suspicion.

A Wonderful New Invention

...Is the...

"O-HI-O" COMBINATION BAKER and STEAM COOKER.

"It Whistles."



Bakes Bread, Cake and roasts Meats perfectly in upper half. In the lower compartment it cooks by steam, or if desired steam can be used in both compartments, by opening a valve. This can all be done over one burner, and saves 50 per cent. in fuel, labor and time. Invaluable for gas, gasoline or oil stoves for Summer use. Great for Summer cottages. Cooks a meal without heating the kitchen. Nothing like it on the market. Fills a long felt want. **Price $4** and up. **$1 Cook Book free,** 4c. postage. **Handsomely illustrated catalogue free.**

A Grand Opportunity for Good Agents, both sexes. Write to-day for terms and territory before it is too late. . . . . **Agencies in all principal cities.**

THE O-HI-O COOKER COMPANY

759 Jeff Ave., Toledo, Ohio

POPULAR MECHANICS

SHOP NOTES

∴ 128 PAGES ∴
204 ILLUSTRATIONS

Easy Ways TO DO Hard Things

Bound in Cloth - - $1.00
Paper Covers - - - - .50

SENT POSTPAID ON RECEIPT OF PRICE

POPULAR MECHANICS

Journal Building Chicago, Illinois

MAY MAKE PAPER FROM BARK.

Experimenting With Japanese Plant, Which Produces Finest Fiber.

Experiments are being carried on by the Department of Agriculture with a new paper plant from Japan, called mitsumata. The experiments are the result of one of the trips of Barbour Lathrop, of Chicago, and D. G. Fairchild, the foreign agent for the Department, to Japan and other foreign countries in search of plants for the government. Mitsumata is believed well adapted to the warmer parts of the United States and is one of the most valuable plants known for the product of bark paper, so much used by the Japanese. It offers an entirely new crop to the south if it can be successfully raised there. Millions of Japanese live upon the revenue created by the manufacture of paper and most of the product is obtained from bark cultivated on an area about one-third the size of the state of Illinois.

Mitsumata is a pretty plant, with branching stems, broad, bright green leaves, and bears a yellow flower. It stands about five feet high and is shaped something like a vase. The plant flourishes upon land too poor for rice growing, is especially adapted to clay soil and from 600 to 2,000 pounds of raw bark is produced upon a single acre. This pulp is worth in Japan from 15 to 16 cents a pound, or just four times as much as the wood pulp imported from America sells for in Yokohama.

Hundreds of tons of filthy Egyptian rags are imported into this country every year to supply the American paper mills. At Mannheim, on the Rhine, the Americans have rag picking houses where rags are collected from all over Europe, the disease infected Levant not excepted, and all is so revolting that the women and children who work in these houses have to keep wet sponges tied over the mouth and nose through which to breathe. When these things are considered it seems that mitsumata might be a grand prize for American manufacturers. The best paper in the world is made by the Japanese from fibers and barks and if mitsumata can be grown here and save the importation of hundreds of tons of disease spreading rags into New York yearly, it will prove a great factor in American resources.

NEW FRENCH IDEAS IN AUTOMOBILES.

New automobile racers in Paris are being fitted with direct axle transmission instead of chains.

A Paris manufacturer has just completed a machine for the Khedive of Egypt which is said to be the handsomest automobile ever built. It is a superb couple-saloon, finished in dark blue with gold lines. The entrance is on two sides. The interior is upholstered in light green cloth and is lighted with electric lamps. A speaking tube communicates with the driver. A complete silver toilet is fixed under the chauffeur's seat. The vehicle is a marvel of luxury.

UNCLE SAM BUILDING THIRTEEN BATTLESHIPS.

America has more battleships building than any other nation in the world. There are thirteen, including the Idaho and Mississippi, in course of construction. Great Britain has twelve battleships being built and is constructing 17 armored cruisers against eleven for the United States. France has nine armored cruisers building; Russia has one completed submarine of 175 tons, and 14 in course of construction.

BUY ROGERS' QUALITY CIGARS.

We promise to send you cigars that exactly fit; cigars to fill EVERY desire of your taste.

Our Guarantee—Every cigar we ship is guaranteed to please you, and if from any cause it does not do so, we will exchange cigars with you or refund your full purchase price. Transportation each way at our expense, and no charge for any number of cigars smoked in testing.

We promise not not to charge you more than HALF WHAT YOU WOULD PAY for the same qualities at retail.

We promise that if you don't think we have filled both promises your experiment COSTS YOU NOTHING.

Could we, with an established success and reputation for quality cigars and good faith in business, make such broad promises if our record and immense list of established customers did not make the promises and the future safe for us both.

WE PREPAY ALL TRANSPORTATION CHARGES

Try us today and you will only regret that you had not done so long before. Our guarantee goes with every shipment. We suggest here only a few of an unlimited variety.

ILLUSTRATION

A Clear Havana, 2 for 25c. suggestion. PICONCIOS 4½ in. Conchas, box of 12, $1.00; 25, $1.75; 50, $3.50.

A Clear Havana filler and Sumatra wrapper, 10c. and 2 for 25c. suggestion. EL PROVOST. 4⅝ in. Perfectos, box of 12, 85c.; 25, $1.50; 50, $3.00.

Or try one of the popular 10c. brands LA MADELLA, 4½ in. Conchas, box of 12, 70c.; 25, $1.25; 50, $2.50.

Or for 75c. we will gladly send you an assortment of 12 cigars, each separately wrapped and described, showing four varieties of 10c. and 2 for 25c. values; or for 50c. an equal showing of High-Grade 5c. and 10c. values. Send for our illustrated catalog, "ROLLED REVERIES" which explains everything.

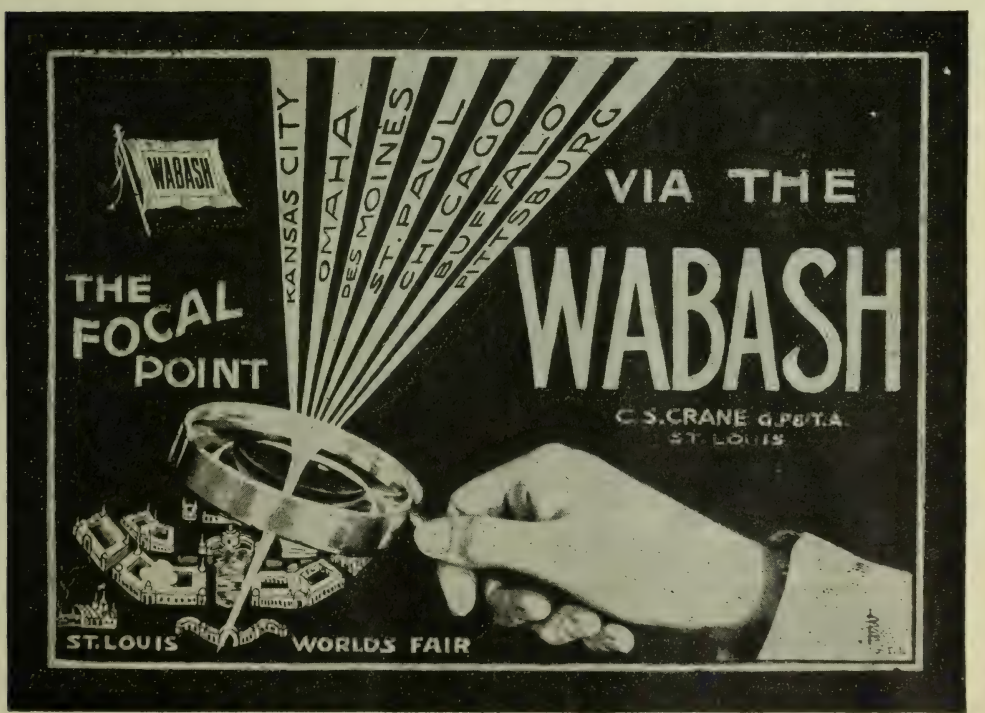
SAVE HALF YOUR CIGAR MONEY

If you smoke 5c. cigars why not smoke 10c. cigars at the same cost? If a 10c. smoker, cut your expenses in two.

Indianapolis, Ind. "Please send me 100 El Provost Perfectos. I have been out for some time and had the misfortune to try the dealers, to my sorrow, and have some cigars for sale cheap. I am done with experimenting."—W. L. Jacobs

Don't delay longer. Write today to

JOHN B ROGERS & CO.
"The Pioneers"
664 Jarvis St., Binghamton, N. Y.



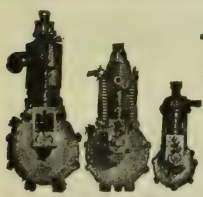
NAME PLATES, TRADE MARKS

THE MEYERCORD CO. INC.
DECALCOMANIA TRANSFERS
NAME PLATES, TRADE MARKS AND ORNAMENTS
OPALESCENT TRANSFER WINDOW SIGNS
CHAMBER OF COMMERCE BLDG. CHICAGO

TRANSFER WINDOW SIGNS

SUPPLIES
DIRT CHEAP
Write for Catalogue and Green Discount
THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago

When You Want Special Jobs Done in Sheet Metal
get in touch with us. We make
Steel Tanks, Conveyor Troughs Hoppers, Trucks, Chutes
In fact, anything of Sheet Steel, Galvanized Iron, Tin or Copper, accurately and promptly at reasonable prices
LYON METALLIC MANUFACTURING CO.
18-20 South Ann St., Chicago.



1 3-4 H. P. Bike Motor $7.50
Castings with Drawings 1904 Model
Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready.
Send for circular to
EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

COPPER FINIALS
TOWER ORNAMENTS
WEATHER VANES
COPPER LIGHTNING RODS
CHURCH CROSSES, etc.
80 page Illustrated Catalogue mailed free
T. W. JONES, Mfr., 18 Fletcher St., N. Y. Est. 1862

SPROCKETS
and EQUALIZING GEARS
IN STOCK OR TO ORDER.
Standard makes of Chain carried in stock. Catalogue free.
CULLMAN WHEEL CO., 521-525 Larrabee St., Chicago

LOW PLUMBING BILLS
Get them by paying right prices for supplies. We sell
SUPPLIES AT WHOLESALE
You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.
B. P. KAROL,
229 W. Harrison St., Chicago.

DO IT NOW!

When you've got a job to do,
Do it now!
If it's one you wish was through,
Do it now!
If you're sure the job's your own,
Don't hem and haw and groan—
Do it now!

Don't put off a bit of work,
Do it now!
It doesn't pay to shirk,
Do it now!
If you want to fill a place
And be useful to the race,
Just get up and take a brace,
Do it now!

Don't linger by the way,
Do it now!
You'll lose if you delay,
Do it now!
If the other fellows wait,
Or postpone until it's late,
You hit up a faster gait—
Do it now!

—Frank Farrington.

BEAVERS' DAMS CAUSE DAMAGE TO BRIDGES.

Industrious beavers well protected by the game laws of the state of Montana are threatening the bridges across the streams. The animals construct dams of such strength and in such a systematic fashion that the rising waters threaten to wash away the bridges. It is said that they are causing much difficulty and destruction along the courses of irrigating streams.

GREAT LAKES HAVE THEIR FIRST WAR VESSEL.

A light unarmored cruiser with an armament of four 1-pounders will be the first Canadian war vessel to sail the waters of the Great Lakes. The vessel is being built by the Canadian government for the protection of fisheries on the Canadian shores of the Lakes and is to be equipped with a powerful searchlight which will be most vigilant.

The vessel will be 176 feet in length over all; beam, 22 feet; moulded depth from top of keel to top of deck beams, 14 feet; will have an 8-foot draught and be of 514 tons displacement. Her two triple expansion engines will drive two cast-iron 4-bladed propellers at 210 revolutions per minute. Steam will be furnished by two steel boilers of the Scotch type and her coal capacity will be 75 tons. Electric lights will be used throughout. The new cruiser is designed for a speed of 16 knots.

"POP" A FAMILY MAGAZINE.

Popular Mechanics:—I can say for your publication that it is the most interesting and instructive magazine I have ever read, and only wish it was a weekly instead of a monthly.

I consider it the best magazine of its kind published, and think it should be in every home. Every one in my family, even to the children, read every page and look forward to the next number with a great deal of pleasure. I expect to be a subscriber as long as it is published. With best wishes for future success, I remain

Yours truly,
S. S. Mayfield, Waco, Tex.

PUTTING THE CANOE IN TRIM.

Before the canoe is used in the spring it should be gone over carefully and put in good order for the boating season. A neat-looking craft adds much to the enjoyment of the canoeing trip.

After a canoe has been used several seasons—three or four, says Sail and Sweep—it should be scraped on the outside with flat steel scrapers. Every inch of it should be scraped very carefully and, necessarily, slowly. The inside of the boat need not be scraped, but should be varnished a thin coat every third year. When all the varnish has been removed from the outside, go over it first with coarse sandpaper and then with finer. When this is done the pores of the wood will be filled with old oil and varnish, but the surface of the wood will be bare, hard and bright. Next give it a coat of linseed oil, let it dry well, and then fill all damaged places with hard wax. The paddles and deck and cockpit hatches should be treated in the same manner.

Varnish the canoe when the weather is warm enough for the varnish to set quickly, varnishing the hull and deck first and then the paddles, hatches, etc. Turn the canoe often during the day so it will dry evenly and be fairly hard by night fall. Use the best spar varnish, which should be thinned with plenty of turpentine, if used in the winter. Spar varnish is a good preservative for all high-grade woods.

After a week's interval give the canoe a second coat of varnish. If the glossy appearance is not desired, a duller finish may be had by rubbing, after the first coat is dry, with crude petroleum and pumice stone. Clean the wood, put on the second coat of varnish, and when that is dry rub lightly with crude petroleum, only.

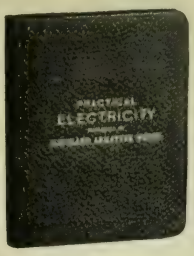
If metal fittings are to be cleaned at all rub them with emery cloth and clean thoroughly, but, as it is impossible in salt water to keep them in perfect condition, many canoeists allow them to corrode. In any case, after the canoe has been varnished and repaired, replace the fittings and rig up the craft for either sailing or paddling, as desired.

STEAM MOTOR LESS EXPENSIVE THAN HORSES.

A miller of Reading, England, has found that it costs him $681.31 less to use a 5-ton steam motor for carriage than the expense of seven horses kept in 1902 for the same purpose. The motor ran 5,272 miles, carried 3,870 tons and burned 41½ tons of coal, an expense of $1,849, including interest on the car and depreciation, whereas the expense for the horses had been $2,530.

GREENLAND'S ONLY NEWSPAPER.

The one newspaper in Greenland is printed at Gothaab, on the Northwest coast, every two weeks. It is called Atnagliuti (The Reader) and Lars Moeller is its editor. He began the paper twenty years ago, when it appeared only once in a while, as the editor would not print a new issue until he had sold all the copies of the last one. The paper was nearly all pictures, the cuts being crudely carved from rocks by Lars' own hands. The Reader's printing press and type were presented to him by Nordenskjold, the Swedish traveler. Under the cuts were printed the titles in the simplest Eskimo language. The few that could read explained them to the others. An ambition to learn to read the language was thus inculcated and in a few years Moeller was surrounded by a reading population of sufficient numbers to support his paper. Finally the editor began to print the prices of eiderdown, skins, etc., and items of news gathered from various parts of Greenland. Now the inhabitants look for the paper anxiously and it wields considerable influence. Moeller has also published books devoted to the preservation of Eskimo fables and traditions.



A School Within Itself

Space will not permit our telling you all about this book, but better still, we give you a chance to examine it for yourself by our offer to refund money if book is not satisfactory upon examination. Under this offer, 11,000 copies have been sold and paid for, and out of this number we have refunded for only fifteen copies. There are nineteen chapters, carrying you from the fundamental principles of electricity through the art to the finished dynamo. Contains a dictionary defining 1,500 words.

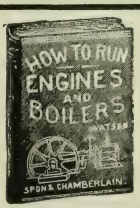
3rd Edition. Price, $2.00 delivered.

CLEVELAND ARMATURE WORKS, Cleveland, Ohio

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for "Architects and Builders' Magazine" monthly.

$2.00 a Year

WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y



7,000 COPIES SOLD

THE BEST BOOK to HELP YOU MAKE MORE WAGES

Written in plain language and fully illustrated.

Spon & Chamberlain Dept. P.M. Liberty Bldg., New York FREE for $1.00

SOMETHING NEW

A book giving dimensions of

Pipe Fittings and Valves

Over 50 tables and many illustrations of all kinds of articles that the draftsmen and architects may need in laying out pipe work on drawings.

Flexible Backs. Good Paper. Postpaid, 50c

ADDRESS

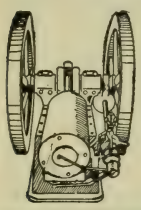
THE DRAFTSMAN

Cleveland, Ohio

MOTORS

$5.00 Buys a
COMPLETE PRACTICAL BATTERY MOTOR—Not a Toy

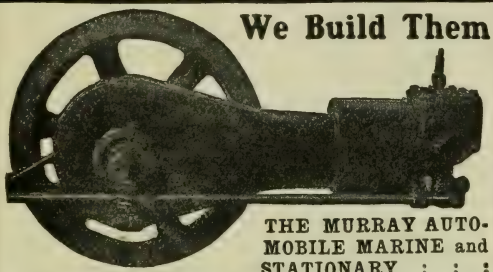
WALSH'S SONS & CO.
250 Washington St. - Newark, N. J.



Gasoline Engines

"HONESTY IS THE BEST POLICY"
THIS IS OUR POLICY
LET US PROVE IT TO YOU
Send for Catalogue. Engines 1 to 500 H. P.
CAVANAUGH & DARLEY
25 West Randolph Street, Chicago

We Build Them



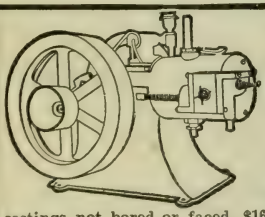
THE MURRAY AUTO-MOBILE MARINE and STATIONARY : : :

GASOLINE ENGINES

Transmission, Gears, Carburetters, Pumps, Mufflers, Etc.
Write for Circular and Prices before ordering.
W. B. MURRAY, 1253 Milwaukee Ave., Chicago

KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago



1-4 H. P. Gas Engine

Castings for $15 up

with blue prints. Cylinder bored out and faced off.
Runs by gas or gasoline, Water Jacketed. 1-2 H. P. castings, not bored or faced, $16.00. Send for catalog of engines, dynamos, electrical supplies.

L. W. GILLESPIE & CO., 228 E. 4th Street, MARION, IND.

NORTHWESTERN ELECTRIC CO.

NEW AND SECOND-HAND
DYNAMOS & MOTORS
WATT-METERS
GUARANTEED ELECTRICAL REPAIRS

Switchboards Built to Order.
Switchboard Instruments Recalibrated. Watt-Meters Changed to Operate on Any Number of Cycles.

69 West Washington St., CHICAGO, U. S. A.

GOVERNMENT CHEMISTS EXPERIMENT WITH HUMAN LIVES.

Cats, dogs and other such animals will no longer serve as subjects for experiments as to the effects of preservatives on the human system, say United States government officials. Human beings must be put to the test; they are constantly consuming foods containing these preservatives so the experiments, in fact, are but an exaggeration of common conditions. Therefore, the United States Bureau of Chemistry, of the Department of Agriculture, called for volunteers to sit at the govrnmental board for several months and partake of special rations.

The American citizen certainly has confidence in those in power and is not so wary of canned foods as many recent editorials would imply, for a great number of hungry men thronged in as applicants! Only 12 of the hollow-eyed victims could be accepted, however, and these were chosen in consideration of physical qualification. Persons who used alcoholic beverages at all were excluded entirely. Persons who used tobacco in moderate quantity were accepted, providing they pledged themselves to use it in regular quantities at specified hours, and did not change the brand during the six months they were subject to experimentation. Each young man further pledged himself to do ample justice to the good things the government placed before him for six months, spending, alternately, 10 days at the observation table, where the experimental food was provided, and 10 days at the recreation table, where the ordinary diet was resumed to assist the system to recover from any harmful effects sustained during the observation period. While attending the observation table they were pledged to use only the food and drink provided, excepting water, which, if used at other times, was to be measured and the quantity drank reported. Otherwise regular occupations were to be continued as before. If any of the chosen 12 died or sustained permanent injury during the period, the Department was not to be held liable.

The first of these experiments were with borax and boracic acid, increasing the quantity as the experiments progressed. To ascertain the results the food and drink were carefully measured according to their kinds, and a sample of each analyzed. Data concerning the excretory functions of the body was kept also and followed up with analytical study. The results of the observations and comparisons made showed that these preservatives, while not highly injurious, produce unfavorable conditions varying with individuals. The symptoms produced were feelings of depression and discomfort, with a dull headache and a sense of fullness in the head. In large quantities the preservatives produced nausea, vomiting and loss of appetite. The effects are of sufficient importance to warrant that notice of the use of these preservatives be required on the food product.

We would suggest that the stomachs of volunteers is not the proper field for reliable investigation. The stomachs of such individuals are too apt to be hardened to anything that comes their way. If the experiments are really important to the welfare of humanity, the subject for experimental purposes should be drafted in. They should be taken from the ranks of those who talk about mother's cooking, from the mansions of the rich, from football teams, and from the most usefully employed of the laboring classes. Let them draft in a few noted epicureans, even though they revolt; these are the stomachs that should ring true, and if preservatives undermine or disturb the health, these delicate "gastronometers" will surely indicate the fact.

Would you like to visit the St. Louis World's Fair? Earn the trip. Write to Popular Mechanics for particulars.

Every Bicycle a Motor Cycle

by using one of our ATTACHABLE MOTOR outfits. Thoroughly practical. Can be applied to any wheel. On the market four years. Also Motors and Castings for Bicycle, Automobile, Marine or Stationary.
LOWEST PRICES. 2-cent stamp gets our catalogue.
STEFFEY MFG. CO., Brown & Pennock Sts., Philad'a, Pa.

DYNAMITE FIRE ALARMS.

Dynamite fire-crackers suspended by means of wires all over the house, from cellar to garret, wherever they can be hidden from view, make excellent fire alarms. They may be placed under chairs, couches, in closets and near stairways, and they cannot possibly explode unless there is fire to touch them off, and in case of fire they speedily sound the alarm, for if well placed, the flames cannot go far without touching off some of them.

ELECTRIC HEADLIGHTS PREVENT ACCIDENTS.

Electric headlights for locomotives are highly commended by J. A. Carney, Master Mechanic of the Chicago, Burlington & Quincy railroad. Roads which have furnished their locomotives with these headlights have noticed a great decrease in the number of crossing accidents and Mr. Carney considers them of inestimable value in warning the public of the approach of high-speed trains.

SHE GUESSED THE SITUATION.

"It's so long since you last called upon me I was beginning to think you were forgetting me," said Miss Pechis, as she came down to the young man in the parlor.

"I'm for getting you," replied the ardent youth, "and it's for getting you that I've called tonight. May I have you?"

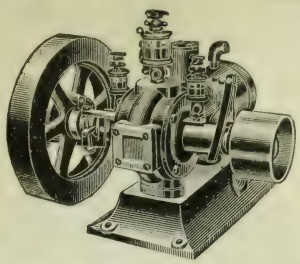
FACTS ABOUT STREET CAR LINES.

There are 16,648 miles of street and interurban car lines in the United States, or an average of about 17 miles of line to each of the 987 existing companies. These lines combined possess 60,290 passenger cars and carried 4,813,000,000 "fare" passengers and 1,063,000,000 transfer passengers, a total of 5,876,000,000 last year.

"PULL" CAUSED THE "IOWA" DISASTER.

Investigation of the explosion of the battleship Iowa's eight guns revealed that when the forgings for these guns were turned out the inspectors objected that they contained defects and sand cracks; that the manufacturers secured rehearings and resurveys until the forgings were finally accepted. The manufacturers did not like to lose the cost of the forgings which the gun factory inspectors rejected and they evidently had friends at court. That this is an isolated case a memory which goes back over ten years may have difficulty in believing. Wherever the fault, it is plain that the acceptance of defective material is a vice which makes our vast naval expenditure look like throwing away money.

SMALL GASOLINE ENGINES

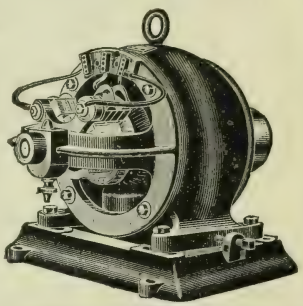


Latest Simplest Cheapest Best

Our new type 1 h. p. gasoline engine has no equal; suitable for all purposes where light power is desired. Starts instantly and runs until you stop it. Has automatic governor; runs at varied speeds.

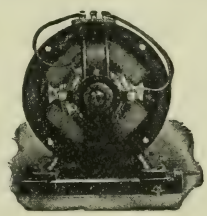
MAKE YOUR OWN ELECTRIC LIGHT.

For residences and small individual isolated plants.
Finest electric light cheaper than kerosene. No combination lighting outfit such as we offer, has ever before been placed on the market.
Price within the reach of all. Send for full descriptive circulars.



Martin Mfg. Co.,
180 W. Madison St.,
CHICAGO

FOR SALE First-Class Manufacturing Plant, making iron and steel products, up-to-date and complete in every respect, doing a fine business—no debts—always a money maker, substantial buildings. Elegant equipment, established 15 years. One hundred thousand dollars required. For particulars address
OLMSTED & BROWN, Chattanooga, Tennessee



Peerless Electric Co.
ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET
141-143 South Clinton Street
'Phone Main 1025 Chicago

Accounts Adjusted

We make a specialty of the adjustment and collection of accounts for corporations, manufacturers, newspapers, magazines, physicians, etc. We also furnish immediately reliable credit reports on any company or individual, city or country.
THE EMMET JOHNSON CREDIT CO.
189 La Salle Street Chicago, Illinois

LAUNDRY MACHINERY, HAND OR POWER.
For Hotels, Dyehouses. Commercial Laundries and Domestic Use.
Write for Catalog P. A. L. DAWSON & CO., 27-31 W. Washiugton St., Chicago.

It Is Possible for You

to keep your razor in perfect shape—sharp, true and keen. Do this, and your razor will pass lightly over the skin, taking the hair off close and clean and without pain. The way to keep your razor in perfect condition is to use the

RADIUMITE

Self-Honing Razor Strop

A Radiumite Strop can be doubled up into a space two inches cube. You can walk on it, jump on it, tie it in a hard knot or strop 50,000 razors on it, but you cannot wear off the Radiumite or harm its wonderful self-honing properties.

MEN everywhere are buying this strop. It is a veritable godsend to the man who shaves himself. With it your razor is kept always in perfect condition without honing.

A Free Illustrated course of instruction in Stropping and the Care of a Razor is sent with each Radiumite Strop.

All for One Dollar

Cut out and send today to

INTERSTATE MERCANTILE CO.

21 Quincy Street **Chicago, Ill., U. S. A.**

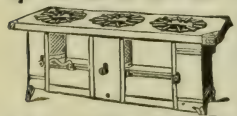
Enclosed find $1.00 (money order or registered letter) for one Radiumite Strop and Instructions as per ad in "P. M." Money to be refunded if Strop is unsatisfactory.

Name.....

Street.....

City..... *State*.....

$40.00 A WEEK.



Reliable man or woman each county as manager to exhibit, take orders, appoint agents for Harrison Valveless Oil-Gas Stoves. Wonderful invention—beats others—Automatically generates fuel gas from kerosene—Miniature gas works—Absolutely safe—Enormous demand—Splendid for summer cooking—Delight customers—Cheap, clean, safe fuel. Gasoline is dangerous. Catalogue Free. Write today. **WORLD MFG. CO., 5687 World B'ld'g., Cincinnati, O.**

This ELEGANT Watch $3.75

Before you buy a watch cut this out and send to us with your name and address, and we will send you by express for examination a handsome **WATCH AND CHAIN C. O. D. $3.75.** Double hunting case beautifully engraved, stem wind and stem set, fitted with richly jeweled movement and guaranteed a correct timekeeper; with long Gold plated chain for Ladies or vest chain for Gents. If you consider it equal to any $35.00 GOLD FILLED WATCH Warranted 20 YEARS pay the express agent $3.75 and it is yours. Our 20 year guarantee sent with each watch. Mention if you want Gents' or Ladies' size. Address **H. FARBER & CO., C31, 23 Quincy St., CHICAGO.**

MARRY WEALTH, BEAUTY. Marriage Directory FREE. Pay when married. Entirely new plan. Send no money for particulars. **SELECT CLUB, DEPT. 448, TEKONSHA, MICH.**

NEW ELECTRIC DANGER SIGNAL.

A Californian has invented an electrical system for warning trains entering the zone already occupied by another train. The system lights an incandescent light right in the engineer's cab, where it could not possibly be obscured by fog or storm. The system involves a third rail in the center of the track for an electric current generated by a ⅛-horsepower dynamo located in the locomotive's cab and operated by its steam, contact with the rail being maintained by brushes underneath the engine. When two engines are on the same track within a distance of two miles of each other an alternating current will be created which will light the danger lamp in front of each engineer, the intensity of the light increasing the nearer the engines approach one another.

The device seems to be the best for its purpose yet invented and will probably be investigated by the many roads where life and property must be safeguarded.

AN ACETYLENE LIFE BELT.

A life belt which may be worn during an entire voyage without attracting notice and yet, if the person wearing it falls overboard, immediately expands four sacs with acetylene gas generated by a charge of carbide of calcium coming in relation with the water, has become a valuable feature of life-saving apparatus. The belt is called the Gros life belt and is composed of four flat, circular pouches connected by a tube. It passes under the arms and two pouches rest against the back; the other two, one on each side of the breast. A small metallic cylinder in each tube end contains the charge of carbide calcium which generates the gas which will keep a person floating head and shoulders above the water.

HOLE IN A LIFEBOAT.

One of the new lifeboats which is said to do good work has a hole in the bottom. The hole is not the result of accident, but is a feature of the boat's construction, and is for water to run out. The boat is described as consisting of two galvanized iron or steel concave shells, the smaller superimposed in such a manner that the concavities are uppermost, and leave a large air space between them. This air space is divided into twelve lateral, one forward, and one after water-tight compartments. In the very center of the boat is a longitudinal opening, which extends the whole length of the space intended for crew or passengers and is really a case for a center-board. It is much wider than necessary for that purpose and is intended partly to empty the boat and partly to hold a center-board consisting of thin sheet steel, weighted with a 600-pound bulb of molded lead. This center-board can be raised or lowered as in ordinary cases. The boats are fitted with oars and sails.

One was converted, during some experimentation, into an automobile lifeboat. It was furnished with a double-cylinder, 12-horsepower gasoline engine which gave a speed of 6 knots per hour.

The engine could not be reversed, so the propeller blades were reversed instead when necessary.

GREATEST INDEX IN THE WORLD.

A catalogue valuable to America is being compiled in London. It is an index of all the manuscripts in the possession of England, France, Holland and Spain which refer to the period of the American Revolution and covers a period from 1763 to 1783.

A United States dispatch agent, Benjamin Franklin Stevens, worked on the index for thirty years and left it nearly finished. There are entered in it 161,000 documents, arranged in three divisions. Fifty volumes of the manuscripts of the documnts as indicated by short titles, 100 volumes of chronological index with a description of each volume and its contents, and thirty volumes of alphabetical index, arranged from the names of the writers and receivers, or if no name is found, the subject. This makes 180 volumes in all.

Congress once considered making an appropriation for this work, but the effort came to naught. The index is valued at $100,000.

"The World's Best Music"

ABSOLUTELY FREE for five days' examination

If there is a piano in your home, you are constantly buying sheet music—and paying high prices for it. It lies in ragged piles around the house and becomes scattered and torn. You lose money by buying music in that way, to say nothing of your loss of time and temper when searching for a particular selection. Why not buy your music in volumes filled with the best selections, and thoroughly indexed? The **"Library of the World's Best Music"** is designed for your needs. Its eight volumes—sheet music size, but light and easy to handle—are crowded with the best vocal and instrumental music, carefully selected by an experienced corps of music editors. If you were to buy the music it contains, one piece at a time, **it would cost you over $200.00.** Through our Musical Library Club—for a limited time—the entire set will cost you one-tenth of that amount and you can pay in

Little Monthly Payments

"The World's Best Music" is complete in **eight large volumes** (four vocal and four instrumental), 9 x 12 inches in size, attractively bound in half-leather or cloth. By means of an ingenious device in binding, the volumes open flat at the piano and remain open. A set contains over 400 illustrations; including numerous chromatic art plates, printed in ten to twelve colors. There are **2,200 pages of sheet music** in the entire library.

IF YOU ARE A PIANIST you will find this collection of music invaluable. It contains **300 instrumental selections** by the best composers, including popular and operatic melodies, dances, funeral marches, and classic and romantic piano music. Such composers are represented as Paderewski, Gounod, Sullivan, Mascagni, Wagner, Mozart, Balfe, and Liszt.

IF YOU LIKE MUSIC but do not play yourself, you cannot make a better present to your wife or daughter than a set of this Musical Library. It means evening after evening of pleasure, for it furnishes in the most compact and simple form all the world's greatest music. This collection is to music what the encyclopedia is to knowledge—the best of all properly proportioned.

IF YOU ARE A SINGER the "World's Best Music" will increase your repertoire. It will place in your hands **300 of the best old and new songs,** duets, trios, and quartets, arranged for all voices and for piano accompaniment. The collection embraces all the old songs of your childhood days, besides the new and popular melodies of the last few years.

IF YOU ARE A STUDENT of music, you will find this Library more than half a musical education. The selections have been made by Reginald DeKoven, Victor Herbert, Helen Kendrick Johnson, Gerrit Smith, and others equally well known in the musical world. As a musical cyclopedia it is unexcelled, as it contains **500 biographies of musicians and 400 portraits.**

The Coupon Cuts the Price in Two!

Our Musical Library Club has secured an entirely new edition of the "World's Best Music" at a price slightly above the cost of paper and printing. On this account we are able to offer these sets at about one-half the regular subscription prices—**payable $2.00 a month.** Through the Musical Library Club—direct from the publisher to the customer—you can secure a set for **$21.00 in cloth binding** and **$25.00 for the half-leather.** These sets were previously sold for $35.00 and $40.00. The edition is small, so to avoid possible disappointment in failing to secure a set, cut off the coupon to-day, sign it, and mail it to us. We will then send you a set **(express paid by us)** for examination and use. After five days' examination, if you are not satisfied, return the books to us at our expense. But if you decide to keep the set, send us $1.00 at the expiration of five days, and $2.00 a month thereafter until the full amount is paid.

What MARGARET E. SANGSTER says:

"I have seldom seen anything so well worth having in one's home. I have lingered over each part with peculiar pleasure, and have no hesitation in saying that you have made a collection of great value, both in the music, and in the artistic and biographical features."

The Riverside Publishing Co.
204 Dearborn St., Chicago, Ill.

CUT OFF AND MAIL THIS COUPON

THE RIVERSIDE PUBLISHING COMPANY
P. M. Chicago, Ill.

Please send me for inspection a set of **"The World's Best Music,"** in half-leather, at no expense or obligation on my part. If I retain same, I will send you $1.00 within 5 days and $2.00 per month thereafter for 12 months.

Name .....
Street .....
City .....

In ordering cloth, change 12 months to 10 months.

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building . . WASHINGTON, D. C.

PATENTS Protect Your Ideas
Consultation Free
Fee Dependent on Success
Established 1864
MILO B. STEVENS & CO.
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

TYPEWRITERS ALL MAKES
All the Standard Machines Sold or Rented Anywhere at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g
Typewriter Emporium, 196 La Salle St., Chicago

MODELS AND SUPPLIES
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Avenue, Chicago

THE WINGET **CONCRETE BUILDING BLOCK MACHINE**

Automatic Adjustable
Makes any size or shape block required in ordinary building operations
Straight & Corner Block
A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

JOHN KIOLA, General Engraver
Seals, Badges, Steel and Brass Stamps,
Embossing Dies, Etc,
Drop a Postal for Free Booklet
R. 59, 155 W. MADISON STREET, CHICAGO, ILL.

SPECIAL MANUFACTURING
Dies and Stamping
--TO ORDER--
SPECIAL MACHINERY, MODELS
EXPERIMENTAL WORK
DROP FORGING DIES AND DROP FORGINGS
Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.
THE GLOBE MACHINE & STAMPING CO.
973 Hamilton St., - Cleveland, Ohio

Send for PREMIUM LIST POPULAR MECHANICS Just Out

HINTS FOR INVENTORS.

By Frederick Benjamin.
(Copyright, 1904.)

IMPORTANT WARNING.

With each appearance of the list of patents in the Patent Office Gazette, patentees are beset with innumerable offers, solicitations, requests, etc., some pretending to want to purchase their patents, while others offer to take an interest in them under promise of procuring patents abroad.

One of the schemes often resorted to by these sharks is to invite patentees to join a fictitious association, under the pretext that by paying the membership fee the patented invention will be widely published in a paper which does not exist, and that they will thereby be rewarded by a sale of their inventions.

Have nothing to do with schemes that involve the payment of a fee for selling your patent unless you have carefully investigated the party and have reasonable assurance that you will get something for your money besides super-heated atmosphere.

SPECIAL INFORMATION FOR INVENTORS.

As soon as an application for patent is filed in the Patent Office the applicant is protected against the grant, without his knowledge, of a patent for the same thing to another person.

Citizens, foreigners, women, minors, and the administrators of estates of deceased inventors, may obtain patents. There is no distinction as to nativity or persons.

It is not necessary to work a United States Patent within any specified period in order to maintain its validity. The patent is granted for seventeen years, and remains valid for that period, whether it is worked or allowed to sleep. The 17 years' term of a patent cannot be extended except by a special act of Congress.

Two or more persons may apply jointly for a patent if they are joint inventors. Where one person is the inventor and the other only a partner, the patent must be applied for in the name of the inventor; but he may secure his partner in advance by executing a deed of conveyance, so drawn that the patent will be issued in both names.

SELLING PATENTS.

Assuming that your invention is new and useful, and that you have a good patent, or have applied for same, the following are the plans we recommend for disposing of the patent right under ordinary conditions:

1st. Have made a complete working model, or drawing of your invention in the best style you can afford. Show the model or drawings to your business acquaintances, and especially to those who are practical men and who are familiar with such inventions. Have them express in writing their opinions of your invention. Sell to these parties, if possible, a part interest in your patent with a view of securing their active co-operation in disposing of the entire patent to others who may be in better position to handle the article patented.

If one man is not able or willing to put up all the money required, get others to join him. It is often easier to get ten men to invest $100.00 each, than it is to get one man to invest $1,000.00.

Have the invention "written up" in an interesting way and published in a paper which reaches the class likely to be interested in such inventions.

2nd. If you can not sell your patent in your own city or locality, have made photographs of your model, or blue-prints of your drawings, and send them to manufacturers of such articles, with copies of the endorsements you have obtained for your invention, and ask the manufacturers to investigate the merits of the invention with a view of buying the patent right. Make your letters short and pointed, and use printed letter heads giving your name and address, the name, and an illustration of your invention. Do not claim extravagant things for it and do not ask a fabulous sum for the patent right. In fact, it is best not to name any price until you have interested the party.

3rd. If you cannot sell your patent by correspondence, take your patent and model and call on as many manufacturers in that line as you can; show them your model and point out the advantages of your invention. If they will not buy, but admit that the invention is good, ask them to put their opinions in writing so you can use them with the others.

4th. If you cannot afford to travel around to see manufacturers, send your model and a copy of your patent to some dealer in similar articles, who is located conveniently to the manufacturers, and offer him a liberal commission for making a sale of the patent for you.

5th. Offer to sell territorial rights for your invention rather than an undivided interest. It is better to sell the right for one or more states than to sell a one-tenth interest. If you can not dispose of the right for a state, offer it for one or more counties at a proportionate price. Every such sale will help you in disposing of other territory.

6th. If you cannot make a sale by any of the foregoing means, the chances are that your invention lacks merit. If, however, you can command capital sufficient to manufacture the articles, do so, and place them on sale with appropriate circular and newspaper advertising, offering them preferably through a jobbing house in that line. If your invention is of a character that needs to be tested before it can be appreciated, have the test made in your own locality first if possible. Do not be discouraged if success does not immediately follow your efforts. On the other hand, do not spend time and money on the invention against the advice and judgment of people who are in position to know more about such things than you are. Better abandon it and devote your energies to something else.

ABSTRACTS OF PATENT LAW DECISIONS.

A patent is prima facie evidence that the patentee was the first and original inventor.

The making of an invention is complete when all that remains to be done is the work of the mere mechanic.

When a man has conceived the main idea of an invention and employs another to embody it, the product will be the invention of the former, though the latter may furnish hints, suggestions and decided improvements, unless the changes made by the latter amount to a new and complete invention.

An inventor may avail himself of the services of skilled laborers, and suggestions and improvements coming from them are to be considered part and parcel of the original invention.

An employer engaged in working out a preconceived plan is entitled to make use of the auxiliary suggestions of the workman.

Trade-marks cannot be registered as labels.

A label bearing a trade-mark cannot be registered till the trade-mark is registered.

Systems of bookkeeping, tabulating, and the like are not patentable.

Systems of keeping accounts, etc., are not patentable.

IF YOU WISH TO BUY

PATENTS

on hardware or mail-order specialties, machinery, anything — or lease them on royalty, write me.

INVENTORS

desirous of selling their patents quickly and to the best advantage, constantly register with me. I can save you time.

CHAS. A. SCOTT
ROCHESTER, New York

Geo. J. Munroe
ATTORNEY AT LAW and FINANCIAL AGENT.

Companies Incorporated and financed in any State or Territory at Reasonable Rates.

Write for Particulars.

SUITES 1011, 1012 and 1013 Hartford Bldg., 140 Dearborn St., CHICAGO

Mention "Popular Mechanics" when writing.

INVENTIONS PERFECTED through designing working drawings, and superintended by MECHANICAL EXPERT of wide reputation and practical experience.

GEORGE WEISS, Mechanical Engineer, 614 Omaha Building, CHICAGO, ILLINOIS

MARK YOUR NAME on your TOOLS, etc.

Price per letter for Steel Stamps		
SIZE OF LETTERS	INITIAL STAMP	NAME STAMP
1-16 in.	18c.	14c.
1-8 in.	18c.	14c.
3-16 in.	23c.	18c.
1-4 in.	35c.	28c.

SEALS $1.70 WITH A **Steel Stamp**

WILLIAM SCHRIDDE
Engraver and Die Maker
35 S. Clark St. Chicago, Ill.

MODELS CHICAGO MODEL WORKS
179 E. MADISON ST., CHICAGO, ILL.
ESTABLISHED 1867 WRITE FOR CATALOGUE OF MODEL SUPPLIES

Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE

W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

W. X. Stevens
(Estab. 1867)
Solicitor of American and Foreign

PATENTS

Honest advice; honest service. My record—97 per cent. successful cases. Booklet free.

1065 Virginia Ave. -- WASHINGTON, D. C.

THE GREAT AMERICAN TEA COMPANY

We are selling the BEST NEW CROP

50c TEAS

in the U. S.

Oolong, Eng. Breakfast, Gunpowder, Souchong, Congou, Mixed, Japan, Young Hyson, Imperial, Ceylon.

Good Oolongs, Mixed and Eng. Breakfast, 25 & 30c a lb.

We are selling the BEST

25c COFFEE

Good Roasted COFFEES, 12, 15, 18 and 20c a lb.

SPECIAL OFFER

ON a SAMPLE ORDER of $5.00 and upwards, of Teas, Coffees, Spices, Extracts and Baking Powder, we will allow you **20 per cent off and pay all express charges,** so that you may thoroughly test the quality of the goods. This is a chance that is seldom offered; it gives all a chance to purchase our goods at **less than cost.**

For full particulars and prompt attention, address

Mr. CARL, Care of

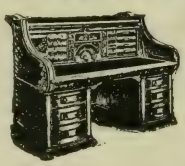
The Great American Tea Company,

31 & 33 Vesey St., P. O. Box 289, New York

IT HELPS BUSINESS

To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs



Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.

174 Wabash Ave., - - Chicago

BIG PAYING BUSINESS

FOR MEN AND WOMEN.

Write for names of hundreds of delighted customers. Make $30 to $50 weekly. Do business at home or traveling, all or spare time, selling Gray outfits and doing genuine gold, silver, nickle and metal plating on Watches, Jewelry, Tableware, Bicycles, all metal goods. Heavy plate. **No experience,** quickly learned. Enormous demand. **No toys or humbug.** Outfits all sizes. **Everything guaranteed. Let us start you. We teach you FREE.** Write today. Address,

H. GRAY & CO., Cincinnati, Ohio.

For Mailing Lists, Addressing, Imitation Letters and all Circular Work, address

TRADE CIRCULAR ADDRESSING CO.

125 Clark Street, Chicago

Ask for 50 page Catalogue of Lists.

$150 FOR $3.50

Agents wanted everywhere for new style (1904) and most up-to-date chewing gum, fortune and love letter writing machine made, and all for one cent. One agent telegraphs, "express me quick ten more machines and 10,000 gum." You can make big money; machines cost agents $3.50 and gum $4.50 per 1,000. Send stamp for particulars. Thos. H. Sherborne, 29 So. Third St., Philadelphia, Pa.

Joint owners of a patent right are not co-partners, and in the absence of any express contract, each is at liberty to use his moiety as he may think fit, without any liability to, or accounting to the other for profits or losses.

Patent rights are co-extensive with the United States, and are not subject to seizure and sale on execution.

The manufacturer of a patented article can continue to affix to it the word "Patented" and the date, even after the patent has expired, without liability, under section 4901.

Owners of a patent are tenants in common and each, as an incident of his ownership, has the right to use the patent or to manufacture under it. But neither can be compelled by his co-owner to join in such use or work, or be liable for the losses which may occur, or to account for the profits which may arise from such use.

One of joint inventors may lawfuly file a caveat on the joint invention.

If a new combination and arrangement of old elements produce a new and beneficial result never attained before, it is evidence of invention.

A mere aggregation of old things is not patentable, and in the sense of the patent law, is not a combination. In a combination the elemental parts must be so united that they will dependently cooperate and produce some new and useful result.

The application of an old device to a new purpose, simply analogous to its purpose, is mere double use.

An old construction in a windmill is not patentable in a paddle-wheel.

An employer is not entitled to any knowledge of the independent inventions of his employe.

As between an employer and an employe, not specially employed to embody the invention of the former, there is no presumption of originality in favor of the employer.

State courts have no jurisdiction of suit for infringement, but are not barred out when patents come in collaterally.

To make experiments, then drop them and only recur to them when another and later inventor has made a success of the idea, makes them "abandoned experiments."

Abandonment of an invention once put in public use inures to the public; a subsequent inventor cannot take a patent therefor.

Alterations cannot be made in pending applications which go outside the original record and model.

An article of manufacture old as to form and general appearance, may have intrinsic qualities due to the process of its manufacture which makes a new and patentable product.

A patent right, like any other personal property, is understood by Congress to invest in the executors and administrators of the patentee, if he dies without having assigned it.

If an employe makes an invention and permits his employer to use it before making application for a patent without demanding any compensation, a license to continue the use may be implied.

Every person who pays the patentee for a license to use his process becomes the owner of the product, and may sell it to whom he pleases or apply it to any purposes, unless he binds himself by covenants to restrict his right of making and vending certain articles that may interfere with the special business of some other licensee.

A "shop right" is a personal license and is not assignable.

A purchaser of patented articles from a territorial assignee does not acquire the right to sell the article in the course of trade outside the territory granted the vendor.

A territorial grantee cannot be restained from advertising and selling within his territory, even

though the purchasers may take the patented article outside of the vendor's territory.

Although an assignment of patent is not recorded within three months, it is binding on the assignor, and he cannot sell it again.

Perpetual motion devices will not be patented.

HOW MATCHES WERE ONCE MANUFACTURED.

The idea of matches was first evolved in the mind of a mariner watching the phosphorescent light upon the sea. The first efficient matches, however, were put upon the market in boxes of two dozen at a shilling a box by John Walker, of England, in 1827; they were called Congreves. Each match had to be drawn through a piece of sand paper to be ignited. For many years matches were made entirely by hand labor, each splint being dipped separately; later, they were tied in bundles and dipped. Still later, the splints were fixed in a frame which held each one separate from the others, and the frame was then brought down on a marble slab covered with the ignition composition, and in this manner about 1,500 were made at a time.

Now, machinery does all the work, and the manufacture of matches is a great and important industry.

PICKING UP A CABLE IN THE AMAZON.

While mending a fault in one of the cables in the Amazon river, a short time ago, the cable ship "Viking" had some unusual experiences.

The fault was localized, but the cable could not be grappled at the spot so the ship moved down stream a mile and there succeeded in hooking it. It was lifted and cut, one end was buoyed, and the ship started picking up towards the fault. A half mile up the course of the cable led in among the coarse grass, or capim. Here there was 12 feet of water and as the ship required but 10 feet to float her, the picking up was continued in the hope of forcing a way through the obstruction.

The work was carried on with great difficulty; grass choked the pumps, and water for the boilers had to be supplied by means of a section hose put over the side and connected to a hand pump. Finally it was necessary to clear the way by the use of knives, choppers, etc. A little farther on the water measured but nine feet and so the cable was cut and part of it abandoned. The channel of the river had changed and where the cable was laid about five years before is now an island overgrown with young trees and burying a length of the cable.

The ship was pulled forward by means of the cable; to pull her back Kedge anchors were run out, but did not hold. Grapnels were then used with the anchors, but did not avail to move her. Finally grapnels were run out over the bow and carried along the grass to the stern of the ship and hooked deeply into the obstruction which was then pulled forward with the winch. By repeating this operation several times, an 8-foot snake being killed in the meantime, the ship was moved. The propeller and choked pumps had to be cleared of grass before it could resume the work and complete the repair.

CUTS AND ENGRAVINGS.

We are prepared to have executed on short notice photo-engravings on metal at reasonable rates, payable in advance. Patentees can supply themselves with any size cut or engraving, either for letter-heads, envelopes or circulars. Rates, 40 cents per square inch, which would make the cost of a 4 by 3 cut (12 square inches) $4.80. No cut will be made for less than $2.

MECHANICAL BOOKS

(*Cloth Bound*)

The Gas Engine, reg. price, 75c
Our special price, **59c.** Postage, 6c.

Mod. Machinist, reg. price, $2.50
Our special price, **$2.** Postage, 14c.

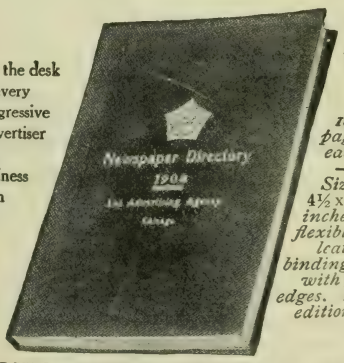
Shop Kinks, regular price, $2.50
Our special price, **$2.** Postage, 14c.

Experimental Science, (two vols.) regular price, $5.00
Our sp. price, **$4.30.** Postage, 20c.

P. H. Ellis-Ackley & Co.
481 Madison St., CHICAGO, ILL.

TWO USEFUL HANDBOOKS

For the desk of every Progressive Advertiser and Business Man



188 pages each

Size, 4½ x 6½ inches; flexible leather binding with gilt edges. 1904 edition.

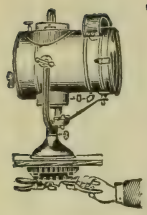
NEWSPAPER DIRECTORIES

1. Directory of Foreign Language Publications in the United States and Canada
Contains all newspapers and periodicals published in any foreign language in the United States and Canada; also the leading newspapers of Mexico, Cuba, Central and South America and the principal cities of Europe. Over 2,000 publications in 30 different languages.

2. Directory of Publications in the English Language in the United States and Canada
Contains practically all important advertising mediums in the English language in the United States and Canada, comprising about 5,000 daily, weekly and monthly publications; also separate lists of the leading religious and agricultural publications. Handy guides and reference books for advertisers.

Either of the above books, leather bound, $1.00; in paper cover, 50 cents, postpaid. Cost of books refunded on first order for advertising amounting to $10.00 or more. Send today for one or both of the above books.

LEE ADVERTISING AGENCY, 79 Dearborn St., Chicago, Ill.



---- ACETYLENE SEARCHLIGHT ----

FOR YOUR YACHT

A neat, compact, self-generating, portable Searchlight of high power for power and sailing yachts. A necessity and ornament to every yacht. Useful in locating buoys, making landings, detecting obstructions, etc. Should be part of every yacht's equipment.

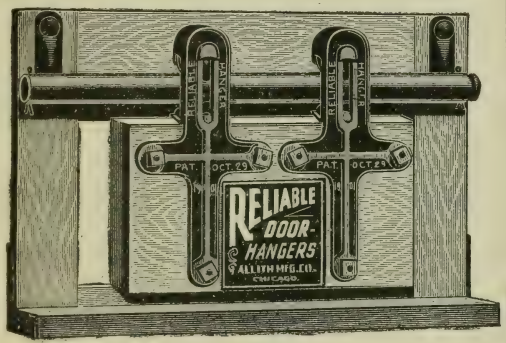
WRITE TODAY FOR CATALOG

AMERICAN ACETYLENE STOVE CO., 506 Masonic Temple, Minneapolis, Minn.

CRANE VALVES

ESTABLISHED 1855

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks

Ours Will Not Bind

Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.

120 South Green Street, Chicago

FARM PRODUCE SHIPPED ON PASSENGER TRAINS.

An English railroad company has undertaken to deliver produce directly from the producer to the consumer. Lists of the names and addresses of producers are distributed in cities along the road and residents there can have any quantity of produce desired sent on the fast passenger trains. The company provides boxes for shipping the produce at small cost. The freight rate for 24 pounds is: 50 miles, 12 cents; 100 miles, 18 cents; 200 miles, 24 cents; any distance over 200 miles, 30 cents straight.

This plan will stimulate home produce trade and Britain will be independent of importation in these lines from the Continent.

PETRIFIED MILK.

In Austria 20,000 quarts of skimmed milk are converted into petrified milk daily, reports United States Consul-General Guenther of Frankfort, Germany. A chemical process precipitates the casein in the milk in the form of a yellowish brown powder. This is mixed with formalin and a horn-like product called milk-stone results. This is used with various admixtures as a substitute for horn, turtle-shell, ivory, celluloid, marble, amber and hard rubber. Handles for knives and forks, paper cutters, crayons, pipes, cigar holders, seals, marble, stone ornaments and billiard balls are now made of skimmed milk. The stone is a valuable by-product of the dairy as gallalith is insoluble, elastic and fireproof and for these reasons is apt to find a good market.

COOLEY COLT CALF AND COW WEANER

The Only Successful Weaner in the World

Guaranteed Not to Make the Nose Sore

Guaranteed to keep any cow from milking herself, no matter how much she has been spoiled by other means, or whether she lies down or stands up.

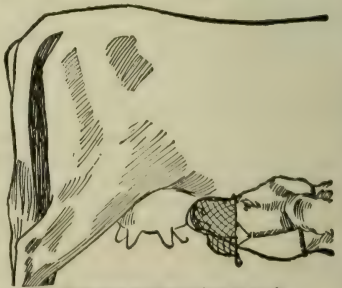
No. 0 for Calf or Colt 1 day to 4 months old, with Halters, complete..... 35c
No. 1 for Small Calf or Colt 1 day to 12 months old, with Halters, complete..... 50c
No. 2 for 2-year-old or Jersey Cow, with Halters.. 65c
No. 3 for big Cow or Horse, with Halters..... 75c

The two small sizes are the best and handiest dog muzzles. Sent express prepaid on receipt of price.

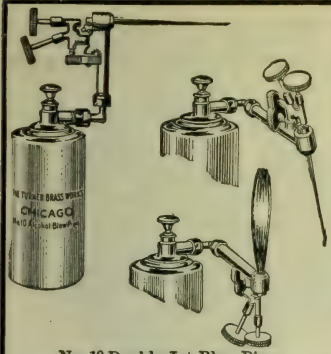
COOLEY & RANDEGGER MFG. CO.

103 South Canal St. CHICAGO, U. S. A.

Position while eating



Position while trying to suck



No. 10 Double Jet Blow Pipe
Capacity 3-4 pints. Weight 2 lbs.

Needle Flame

Over 3000

The Turner Double Jet Alcohol Blow Pipe No. 10

Has the nearest approach to the Oxy Hydrogen Blow Pipe Jet invented and is made so compact it can be carried in the pocket. The fuel is wood alcohol and it will run 3 hours at full blast from one filling. The flame is non-oxidizing and can be regulated from a needle point to a brush flame. Unexcelled for jeweler's and optician's work, fine brazing and soldering.

LABORATORY AND EXPERIMENTAL WORK AND LEAD BURNING

SEND FOR CIRCULAR

The **TURNER BRASS WORKS**

55 **North Franklin St., Chicago**

Our New **FLASH BOILER**

For 1904

No burning of boiler—No water gas—No smoke
Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

Condensers, and other appliances are marvels of mechanical development.

Barton Boiler Company

SOLE MANUFACTURERS,

4230 State St., Chicago, Ill., U. S. A.

Write for full particulars

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

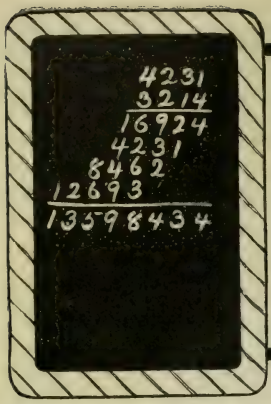
POPULAR MECHANICS CO.

MACHINERY BARGAINS

SEND FOR MY PRINTED PRICE LIST OF

Automatic and Slide Valve Engines, Hoisting Engines, Boilers, Heaters, Air Compressors, Rock Drills, Crushers, Locomotives, Steam Shovels, Pile Drivers, Dump Cars, Dredge Machines, Traveling Derricks, Cableways, Concrete Mixers, Coal Mine Hoists and Machinery Generally. I handle both New and Second-hand.

WILLIS SHAW, - - - - 171 La Salle St., CHICAGO



Multiply This in Your Head

Wouldn't you like to be able to figure this and hundreds of other similar problems in your head? Wouldn't you like to be able to add, subtract, multiply and divide any problem almost instantly without writing any partial product—to be able to simply write the answer?

OUR FREE BOOK "RAPID CALCULATION"

thoroughly explains a method which will make you a master of figures. It describes a system by which you can figure instantly the most intricate sums in your head; handle groups of figures and fractions as easily as single whole figures; in fact, cut the work of figuring in two.

A better position and a large salary have come to hundreds who have read this book. If you want to better your position, to increase your salary, to make yourself worth more to yourself and your employer, to hold the whip-hand in financial transactions, to make your work easy and interesting instead of tiresome, you should write for this book at once. It will cost you nothing but the trouble of asking for it. A postal card will bring it to your very door. It may cost you a good position or a valuable promotion to neglect this opportunity. Write for it to-day before you forget it. Address

Commercial Correspondence Schools, 147 J. Schools Bldg. Rochester, N. Y.

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

LEARN LAW AT HOME

We can teach you by mail. 14 years experience enables us to say this positively. Our thousands of graduates prove it. Plan endorsed by lawyers and educators. Three courses: College, Preparatory and Business law. Liberal terms. Special offer now. Catalog free.

THE SPRAGUE CORRESPONDENCE SCHOOL OF LAW,
872 Majestic Building, Detroit, Mich.

Be a Taxidermist

Learn to mount birds, animals, heads, etc. WE CAN TEACH YOU BY MAIL. Decorate your home and den. Turn your spare time to cash. This art is very fascinating, profitable and easily learned by anyone. Standard methods, expert instructors, reasonable tuition. Delights every hunter, angler and nature lover. We want every reader of POPULAR MECHANICS to see our new illustrated catalog. It's free. May we send you one? THE NORTHWESTERN SCHOOL OF TAXIDERMY, Inc., Suite 58, Com. Nat. Bk, Omaha, Neb.

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,
127 NASSAU ST. ROCKFORD, ILL., U. S. A.

RUPTURE

Our 24-page book free describes the greatest invention of the 20th Century, for the relief and cure of Rupture. Shows interesting photos from life and contains new and valuable information. Greatest trial offer ever made by any firm. You will be interested. Write today.

DENCE & MERY, 160 Mery Block, Toledo, O.

THE WESTERNER'S LAMENT.

Th' city's no place fer a feller who's used to th' life of th' camp,
Layin' down with th' stars for companions by th' light o' th' heaven's great lamp;
With th' smell o' th' hoss-mint an' roses from th' canyons so wide an' so deep,
Where th' crick's talkin' sweet to th' willers an' rockin' th' lilies to sleep;
Where th' whip-o-wills call to th' night time an' th' wind sighs soft thro' th' pines,
An' talks to itself in th' clover or stirs in th' raspberry vines,
Or kisses th' tips of th' foxglove or down in th' dusk an' th' gloom.
A-wooin' with tender caressin' th' dark little violet's bloom.

Th' city's no place fer a feller whose heart is built on th' plan
Of freedom from styles and from fashion like th' heart of a natural man;
Whose hand's ever out to th' stranger, whose home is his while he stays,
Who's tryin' to be a straightforward man in these coin-chasing days.
Th' city's no place fer a feller who's pillowed his head on th' sod,
Alone with th' stars fer companions, alone with himself an' his God;
Alone where th' stream tells a story to th' canyon so wide an' so deep,
Alone where th' voices of nature sing his heart an' its troubles to sleep.

—ROBERT V. CARR.

MAY MEND THE OLD LIBERTY BELL.

The old Liberty bell may sometime peal anew with the same tone as when it rang out our Independence.

In Germany many bells have been successfully mended by a Swedish family named Olson who keep their process a profound secret, and wherever they work they require the authorities to guard them from intrusion during their operations which are usually performed in a large field, fenced in by canvas. It is believed that in their method the bell is encased inside and outside in a plaster of Paris cast, leaving the crack open. The composition of the bell is duplicated and poured into the crack, closing it perfectly and then the clapper is hung to strike in a different spot.

The proposition of mending our own historic bell is to be brought before Congress. Meanwhile it is on exhibition for the patriotic and the curious at the St. Louis World's Fair, but it is doubted that our patriotism will ever ebb so low as to permit the national irreverence of having it mended.

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

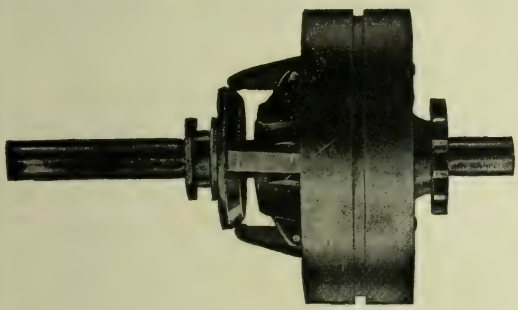
WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

Successors to THE P. J. DASEY CO.

1339 Michigan Blvd. Chicago, Ill., U. S. A.

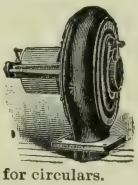
AUTOMOBILE PARTS

OF EVERY DESCRIPTION.

Write for Catalog and Prices.

OTTO KONIGSLOW,

CLEVELAND, OHIO

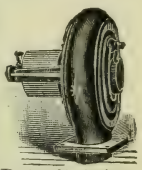


WATER MOTORS

¾ to 15 H. P.

for Ice Cream Freezers, Coffee Mills, Churns, Printing Offices and small Electric Light Plants, etc.

Electric Motors and Generators, Combination Water Generator for charging storage batteries. Send stamp for circulars.



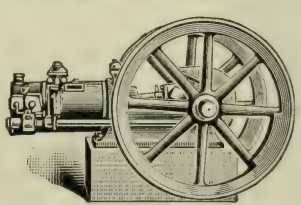
C. S. PIPER & CO., Detroit, Mich.

CRANE FITTINGS

ESTABLISHED 1855

OUR EXHIBIT at the St. Louis World's Fair

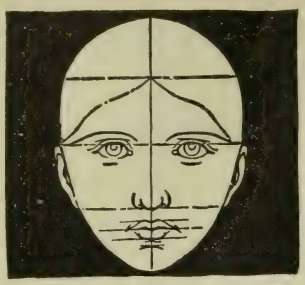
consisting of **17** Gas and Gasoline Engines, **11** of which are piped up and running, is the largest, most comprehensive and most attractive display in this line ever made.



Our friends will find at the space good drinking water, electric fans, comfortable chairs and writing materials. Visit us, see our exhibit and test our hospitality.

The OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street MINNEAPOLIS: 318 3rd Street OMAHA: 1108 Farnum St.



WHAT $1 Will Do

One Dollar, if sent at once, will bring you a copy of

"How to Illustrate"

A PROFUSELY ILLUSTRATED SELF-INSTRUCTING BOOK

on an entirely new plan—by Charles Hope Provost, *artistic contributor to high-class magazines and weeklies everywhere—teacher of 4000 people by mail—originator of correspondence art instruction*

1. It will bring a complete and practical course of art instruction right into your own home.

2. It will not only tell you what is necessary to become a successful illustrator but will show you how to do it.

3. It will instruct you in the practical points of illustrating from the professional standpoint, which few, even the graduates of our best art schools learn, until, often too late, they are taught by experience.

4. And finally it tells you how to sell your work after you've learned how to produce it.

CONTENTS.

TECHNIC—Working with pen, brush (oil and water color), pastel, grease and conte crayon, lead pencil, carbon pencil, scratch paper, chalk plate, Ben Day machine, silver print work, etc. Also the various effects used by pen artists, including quick and slow lines, English and American styles of treating zig-zag lines, hooked lines, quick lines, double cross hatching, stippling, spatter work, etc. Wash drawings. Distemper drawings. Tracing and copying photographs. What materials to use, including papers, canvases, and bristol boards. Tools and how to handle them. Drawing from nature. Drawing from memory, with table showing comparative measurements of different parts of the human body—head, hands, feet, legs, arms, etc. COLOR—primary and secondary colors, etc., explained. How to mix different shades, etc. ARTISTIC ANATOMY—The bones and muscles as applied to pictorial work. LETTERING—Copying and originating, Roman, block, old English, and script styles shown. Elementary, historic, and geometric ornament. Conventionalization of flowers, ornamental composition, pictorial composition. FACIAL EXPRESSION—Sorrow, joy, anger, fear, contempt, laughter. Aerial and linear perspective. BUSINESS DETAILS—How to sell pictures, how to get a position as an artist, prices and salaries paid, lists of names of publishers and others who buy work, how to pack pictures to send by mail or express, etc., etc. Explanations of various engraving and reproductive processes.

"How to Illustrate" sent prepaid to any address in the world for $1.00. (Limp Covers.) A more handsomely bound edition in cloth covers, $1.50 prepaid.

THE ART OF CARICATURE,

a handy book (complete in itself on this subject) and containing specimens and explanations of all kinds of caricature, from the simple work of the student to the finished drawings of the best artists. Prepared by a professional artist of twenty years' experience. Nineteen pages of diagrams and illustrations. A 12-page supplement sent with this book is alone worth its price.

PRICE 50 CENTS A COPY, POSTPAID

or by combining with order for "How to Illustrate" may be had for 25 cents.

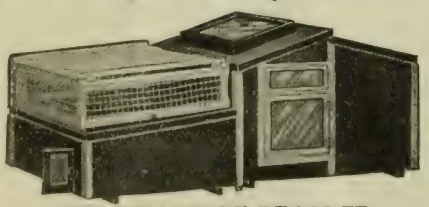
Remit to-day as this offer may be withdrawn at any time, or send for free descriptive circular.

BROWN PUBLISHING COMPANY

Room 901, 114 Fifth Avenue, New York

Remit by Express, P. O. Money Order or Registered Letter.

TWO BROODERS IN ONE



THE TWO-STORY BROODER

Both floors heated by one lamp—contains 25 square feet of floor space, simple to operate, well constructed. Investigate. Illustrated Catalogue Free.

The Two-Story Brooder Co.

161 LA SALLE ST., CHICAGO, ILL.

OYSTER EATS AT ALL TIMES.

The oyster keeps its mouth open always and constantly receives food into it. However, this is due to its organism rather than to greed. Dr. W. K. Brooks in a book on the oyster tells how it feeds:

"The surface of the gills is covered by an adhesive excretion for entangling the miscroscopic organisms contained in the water, and as this circulates over and through the gills they stick fast like flies on flypaper. The hairs which drive the water through the gills push the slime, with the food which has become entangled in it, toward the mouth, which is well up toward the hinge; for it is hardly necessary to say that what the oystermen call the mouth is only the opening between the halves of the mantle.

"On each side of the mouth there is a pair of fleshy organs called the lips, although they are more like mustaches than lips, for they hang down on each side of the mouth. One on the right is joined to one on the left, above the mouth, while the other two are joined below it, so that the mouth itself lies in a deep groove or slit between the lips.

"The ends of the gills fit into this groove, and as the hairs slide the food forward it slips at last between the lips and slides into the mouth. This process goes on whenever the oyster is breathing and the oyster's stomach is usually well filled."

TRICKS OF SAILORS.

On board ship fresh or soft water is only issued at certain hours. There is then a general scramble for buckets which are not numerous enough for the demand. Some of the older salts who, from force of habit, think they own the bucket, bore a hole in the bottom and cut it square or diamond shape and then whittle out a plug to fit the hole. When the bucket is not in use he carries the plug in his pocket. Should any other salt get his bucket he is not long in finding it, and issuing a challenge to the party having it to come forward in the forecastle (pronounced fokersal) and fight it out before all hands.

SHIP LOCOMOTIVES TO JAPAN.

Twenty-four locomotives hurriedly built in Philadelphia for the Japanese government have been shipped to the far east. The utmost secrecy was maintained in shipping the engines to prevent their falling into the hands of the Russians.

They tell of a Chicago physician who, opening the door of his consultation room, asked: "Who has been waiting the longest?"

A tailor who had called to present his bill, rose and said: "I have, doctor; I delivered your clothes to you three years ago."

DEEPEST HOLE IN THE WORLD.

The deepest hole in the world was bored by the Prussian government to test for the presence of coal. It is 4,560 feet deep, 11 inches wide at the top, and 2 inches at the bottom where the temperature is 118 degrees Fahr. It cost $25,000 and required 3½ years to bore it.

The old Irish potato's days are numbered, for a potato called the Uruguay Irish potato is rapidly supplanting it. This potato is said to be of enormous size and immune from disease. The French are beginning to cultivate it.

YOU CANNOT "MAKE BRICKS WITHOUT STRAW" BUT YOU CAN SECURE ANY OF THESE

High Grade Tools Without Money

The following carefully selected list of tools includes those which every mechanic needs, and which everyone who engages in mechanical work as a recreation will greatly desire to possess. We have selected a well-known brand, the excellence of which for quality and accuracy is beyond criticism. They are all from the celebrated works of the L. S. Starrett Company, manufacturers of fine mechanical tools. Every tool in these lists can be easily earned by securing a small club of new yearly subscribers to Popular Mechanics;

ANY TOOL IN THIS LIST FOR ONE NEW SUBSCRIBER

		Retail Price.
No. 303	4-in. Spring Tempered Rule	$ .45
No. 403	4-in. Beveled Edge Rule	.45
No. 330	4-in. Narrow Hook Rule	.45
No. 391	Spring Tempered Center Gage	.45
No. 450	Folding Pocket Rule in case	.50
No. 135	Nickel Plated Pocket Level	.50

ANY TOOL IN THIS LIST FOR TWO NEW SUBSCRIBERS

No. 303	Spring Tempered Rule, 9-in	1.00
No. 403	Beveled Edge Rule, 9 in	1.00
No. 420	Hook Rule, 6 in	1.00
No. 21	Thin Straight Try Square, 2 in.	1.00
No. 125	Adjustable Caliper Gage, 2½-in	1.00
No. 193	Protractor	1.00
No. 40	Screw Pitch Gage	1.00
No. 172	Thickness Gage	1.00
No. 87	Mercury Plumb Bob	1.00
No. 146	Adjustable Hack Saw Frame and Blade	1.00
No. 104	Speed Indicator	1.00
One Dozen No. 116	Asst. Nail Sets, in case	1.15

ANY TOOL IN THIS LIST FOR THREE NAMES EACH

ANY TOOL IN LIST 1 AND LIST 2, OR,

No. 405	Patent Draftsman's Scale, 12 in	$1.50
No. 380	Steel Straight Edge, 18 in	1.80
No. 11	12-in. Combination Square	2.00
No. 60	6-in. Reliable Try Square	1.25
No. 425	Slide Caliper Rule, 3 in	2.00
No. 15	3-in. Universal Bevel	1.50
No. 6	Screw Pitch Gage	1.50
No. 36 or 37	6-in. Lock Joint Transfer Calipers	1.50
No. 186	Drill and Steel Wire Gage	1.50
No. 132	6-in. Level	1.50

TOOLS IN THIS LIST FOR FIVE NAMES EACH

ANY TOOL IN LIST 2 AND LIST 3, OR

No. 380	24-in. Straight Edge	$2.40
No. 510	Steel Tape in Leather Case, 50 in	4.00
No. 9	12-in. Combination Square Set	4.00
No. 33	Hardened Steel Combination Squares, Drop Forged	3.00
No. 20	4½-in. Hardened Edge Solid Steel Square	3.50
No. 25	4-in. Caliper Square with Adjustable Screw	4.00
No. 66	Locomotive Guide Liner	3.00
No. 57	New Universal Surface Gage, 12 in	3.00
No. 97	12-in. Improved Level for Testing Shafting	2.50
No. 197	12-in. Electrician's Level Non-Magnetic	3.50
No. 163	24-in. Draughtsmen's T. Square	3.50

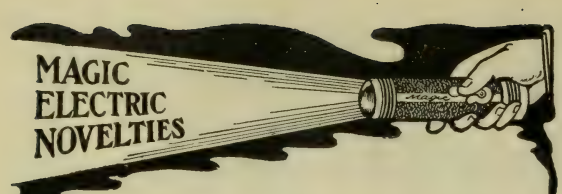
TOOLS IN THIS LIST FOR TEN NAMES EACH

ANY TOOL IN LIST 1 AND LIST 5, OR,

No. 3	1-in. Micrometer in Case	$6.50
No. 113	1-in. Micrometer in Case	7.50
No. 2	2-in. Micrometer in Case	7.25
No. 124	B. Inside Micrometer	6.25
No. 360	Universal Bevel Protractor	5.75
No. 196	Universal Dial Test Indicator with Tool Post	7.50

Any tool in the Starrett Catalog desired, and not given above, will be given as a premium for a club. ∴ ∴ For particulars address

POPULAR MECHANICS : : Journal Building : : CHICAGO



Magic Electric Lights

Illuminate darkest places great distances. Gives 8,000 brilliant lights before renewing dry battery. No wires, no chemicals, no danger, no trouble. Always ready, just touch the button. Carried in the pocket or placed in a keg of GUNPOWDER without danger. Useful to everyone. THE MOST SERVICEABLE LIGHT EVER INVENTED. PRICES, $1.50 to $5.

ELECTRIC BARGAINS

Battery Fan Outfit	$ 7.85
Telephone, complete	$2.50 & 5.95
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	$1.00 to 6.50
Battery Motors	75c to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Porch Lamps	3.00
Electric Carriage Lamps	5.00
Water Motor and Dynamos	10.00
Miniature Electric Railways	3.25
Electric Scarf Pins	1.50

Our new Free Catalogue describes OVER 100 other novel and useful electrical articles. SEND FOR IT TO-DAY. All goods guaranteed. We promptly refund money if dissatisfied.

AGENTS WANTED—YOU CAN MAKE BIG MONEY

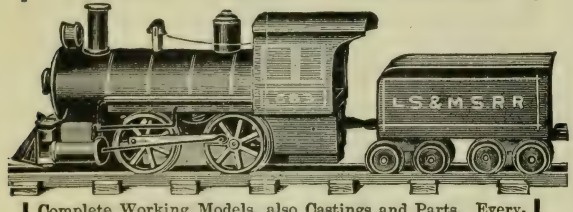
selling our goods. They are VERY RAPID SELLERS. No experience is necessary. We show you how. Exclusive territory given. Don't wait. WRITE TO-DAY for NEW CATALOG and FREE particulars.

J. W. SCRIBNER & CO.,

161 Niagara St., Tonawanda, N. Y.

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio

The World's Headquarters for

ELECTRIC NOVELTIES and SUPPLIES

If It's Electric We Have It.—We Undersell All

Fan Motors, $2.00 to	$15.00
Battery Table Lamp,	3.00
Battery Hanging Lamp,	10.00
Telephone, complete, $2.50 to	5.95
Electric Door Bells,	1.00
Electric Carriage Lamps,	5.00
Hylo Turn-Down Lamps,	.60
$8 Medical Batteries,	3.95
$12 Belt, with Suspensary,	2 50
Telegraph Outfits,	2.00
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights, $2 to	3.50
Electric Railway,	3.25
Pocket Flash Lights,	1.25
Necktie Lights,	1.00

SEND FOR FREE BOOK.

$3 Electric Hand Lantern. Agents wanted.

OHIO ELECTRIC WORKS, -- Cleveland, Ohio

A NIGHT RIDE ON THE LIMITED.

A quiver of steam in the station's hum,
A long, black monster standing dumb.

A steady pull at lever and cord,
A sharp, clear cry of "all aboard,"
And the tardy passenger rushes pell-mell
At the warning of whistle and clanging of bell!
Chug, chug—swish, swish! With avalanche force
Moves the mountain of metal, this steel-ribbed horse,
Outstripping the wind in a merry race,
While a specter floats in its erstwhile place.

A dazzle like daylight ahead on the track—
A flame starred midnight hurtling back!
Here flits a freight-house, silent and grim,
A puffing yard-engine, with headlight dim,
A switch-tender's cabin, a siding of cars—
A lightning express seems to plunge from the stars
And is gone; a single, hoarse cry
Gives us greeting of how d'ye do and good-bye!

Now a glimpse of the river, a clattering bridge,
A loud-roaring forest, a pine-crested ridge—
Farm houses, rail fences, a lone country maid,
All aflutter at a crossing and seems half afraid;
Wide-spreading meadows and moon-silvered corn,
And drooping buds 'waiting the breath of the morn,
Then neatly-hedged gardens and cottages trim,
And village church sounding with evening hymn!

A hound held in leash by a hand of steel,
A chariot gliding on magic wheel,
A leviathan sporting on billows of steam,
A demon that sweeps through your midnight dream!
Chug, chug—swish, swish! With lessening roar,
And fitful flash from the furnace door;
While wailing whistle and clanging bell
Awaken the echoes of valley and dell!

A quiver of steam in the station's hum,
A long, black monster standing dumb!

RAPID JUSTICE BY TELEPHONE.

It cost Alexander Robinson, of Indianapolis, $10 to answer a local telephone call. When he put the receiver to his ear he heard this:

"Hello, is this Alex. Robinson?"

"Yes, this is Robinson. Who wants me?"

"I do. I am Justice of the Peace Smock."

"Well, what do you want, Squire?"

"I've got a complaint against you for having a seine net in your possession. Are you guilty or not guilty?"

"Guilty, Squire, but what in the——"

"Guilty, are you? Well, I fine you five dollars and costs," and the Squire hung up the receiver, while Alex. used "hello" and other words.

CHICAGO ONE-HALF GOAT.

What is three-sevenths of chicken, two-thirds of cat, and one-half of goat?"

"Of course you give it up."

"Well, the answer is Chicago. 'Chi' is three-sevenths of chicken; 'ca' is two-thirds of cat, and 'go' is one-half of goat. Pretty good, isn't it?"

Electric Novelty Bargains

Catalogue for Asking.

ELECTRIC NOVELTY CO.,
16 E. Market Street,
Indianapolis, Ind.

Learners Telegraph Set,	$1.75
Vest Pocket Light,	1.50
Electric Bicycle Lamp,	3.50
Electric Scarf Pin,	1.00
Ivory Elk Head or Skull Pin,	2.50
Electric Gas Lighter,	1.50
Electric Door Bell Outfit,	1.00
Battery Motors,	1.00
Complete Medical Battery,	2.00

SUNBURN

quickly relieved and surely cured by

Hydrozone

It acts like magic and is absolutely harmless. **A Trial Bottle Free** which will absolutely prove this statement sent for 10c. to pay postage. **Don't Wait** until you have a bad case but get it now and have it at hand when needed.

Sold by leading druggists.
None genuine without my signature.

Prof. Charles Marchand

L 63 Prince St., New York.

Send for free Booklet "How to treat diseases," containing hundreds of unsolicited testimonials of wonderful cures.

THREE OUT OF FIVE

Men suffering from weakened nerve force, constant depression, gloomy forebodings, fast becoming unfitted for active business life, fail to attribute their deplorable state to the proper cause. They know they

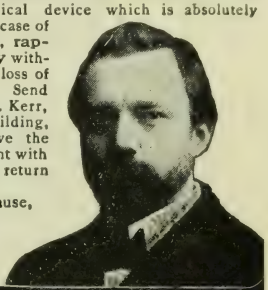
HAVE VARICOCELE

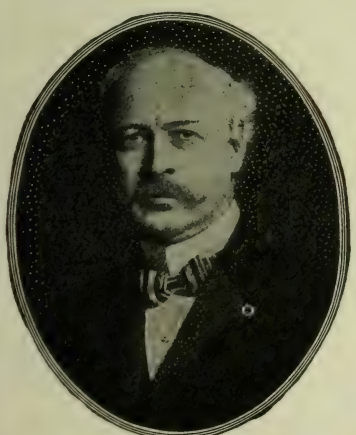
as they have suffered much discomfort on account of it, particularly while standing. But the evil effects due to Varicocele are so gradual that they neglect it until the entire system is undermined and they are forced to realize that something must be done to prevent them from breaking down completely. To such sufferer I say, don't fall into the hands of Quacks—don't submit to the knife—don't pay enormous sums to so-called specialists—

Cure Yourself at Home

I have successfully treated and cured thousands of cases with a patent mechanical device which is absolutely guaranteed to cure any case of Varicocele painlessly, rapidly and permanently without inconvenience or loss of time from business. Send only **$2.00** to Mark M. Kerr, M. D., 703 Park Building, Cincinnati, and receive the full guaranteed treatment with simple instructions by return mail.

A treatise on the cause, effect and cure of Varicocele sent sealed **FREE OF CHARGE.**





H. J. TILLOTSON, M. D.

The Master Specialist of Chicago, who Cures Varicocele, Hydrocele, and treats patients personally
Established 1880.
(COPYRIGHTED)

VARICOCELE
HYDROCELE

Cured to Stay Cured in 5 Days
No Cutting or Pain. Guaranteed Cure or Money Refunded

VARICOCELE Under my treatment this insidious disease rapidly disappears. Pain ceases almost instantly. The stagnant blood is driven from the dilated veins and all soreness and swelling subsides. Every indication of Varicocele vanishes and in its stead comes the pleasure of perfect health. Many ailments are reflex, originating from other diseases. For instance, innumerable blood and nervous diseases result from poisonous taints in the system. Varicocele and Hydrocele, if neglected will undermine physical strength, depress the mental faculties, derange the nervous system, and ultimately produce complicated results. In treating diseases of men I always cure the effect as well as the cause. I desire that every person afflicted with these or allied diseases write me so I can explain my method of cure, which is safe and permanent. My consultation will cost you nothing, and my charges for a perfect cure will be reasonable and not more than you will be willing to pay for the benefits conferred.

Certainty of Cure is what you want. I give a legal guaranty to cure or refund your money. What I have done for others I can do for you. I can cure you at home.

Correspondence Confidential. One personal visit at my office is preferred, but if it is impossible for you to call, write me your condition fully, and you will receive in plain envelope a scientific and honest opinion of your case, Free of charge. MY HOME TREATMENT IS SUCCESSFUL. My books and lectures mailed free upon application.

H. J. TILLOTSON, M. D., 271 Tillotson Bldg., 84 Dearborn St., CHICAGO

The Open Court

AN ILLUSTRATED MONTHLY MAGAZINE

Devoted to the Science of Religion, The Religion of Science and the Extension of the Religious Parliament Idea.

10 cents per copy - - - - - - $1.00 per year

SCIFNCE is slowly but surely transforming the world. Science is knowledge verified; it is Truth proved; and Truth will always conquer in the end. The power of Science is irresistible. Science is the still small voice; it is not profane, it is sacred; it is not human, it is superhuman; Science is a divine revelation.

Convinced of the religious significance of Science, *The Open Court* believes that there is a holiness in scientific truth which is not as yet recognized in its full significance either by scientists or religious leaders. The scientific spirit, if it but be a genuine devotion to Truth, contains a remedy for many ills; it leads the way of conservative progress and comes not to destroy but to fulfil.

The Open Court on the one hand is devoted to the *Science of Religion;* it investigates the religious problems in the domain of philosophy, psychology, and history; and on the other hand advocates the *Religion of Science.* It believes that Science can work out a reform within the Churches that will preserve of religion all that is true, and good, and wholesome. Sample copies of *The Open Court* sent on request together with illustrated catalogue of important publications for the Study of Religion. Published by

THE OPEN COURT PUBLISHING COMPANY, 326 Dearborn St., Chicago.

4 Trains a Day

VIA THE

MONON ROUTE

CHICAGO, INDIANAPOLIS & LOUISVILLE RAILWAY

and C. H. & D. Ry.

Only 8 Hours

from

CHICAGO

to

CINCINNATI

BY DAY, Parlor and Dining Cars.

BY NIGHT, Palace Sleeping and Compartment Cars.

CHAS. H. ROCKWELL, Traffic Manager.

FRANK J. REED, Gen. Pas. Agt.

200 Custom House Place, CHICAGO.

PLAYS FOR AMATEURS OR PROFESSIONALS; also Self-Educational Books on Amusements, Reference, Mechanics, etc. at popular prices. Send for our Illustrated Book Catalogue. Sent FREE to any address.

FREDERICK J. DRAKE & CO.

211 E. MADISON STREET, CHICAGO, ILL.

BE YOUR OWN BOSS

MANY MAKE $2,000 A YEAR

You have the same chance. Start a Mail Order Business at home. We tell you how. Money coming in daily. Enormous profits. Everything furnished. Write at once for our "Starter" and FREE particulars.

P. M. Krueger Co., 155 Washington St., Chicago, Ill.

BOOK REVIEWS.

MODERN ELECTRICITY. By James Henry, M. E. and Karel J. Hora, M. Sc. 355 pages; 150 illustrations. Laird & Lee, Chicago. Price, cloth, $1.00; leather, $1.50. A practical encyclopedia of all that the electrical engineer, artisan, apprentice or student may desire to know regarding electricity and its application. Fundamental principles are treated simply so that the busy man who wishes to know more about the uses of electricity can take up the book and get a clear understanding of an important fact in a few minutes. The information it gives is so concise and so devoid of theories and technical phrases that any boy could study it with profit, and find that the knowledge he had acquired from the work was capable of being turned to the practical purposes of every-day life. There is nothing about the illustrations (which have been specially prepared for the work) to confuse the understanding; all the diagrams show clearly only the point in hand. Among the features of the work which are of especial interest are chapters on the construction of electric railways, practical methods and estimates for the same, and also electric light engineering, power transmission engineering and electrolysis are thoroughly explained. Questions and answers exhaust each subject and practical problems and rules worth memorizing greatly increase the value of the book.

SPANGENBERG'S STEAM AND ELECTRICAL ENGINEERING. By E. Spangenberg, M. E., Albert Uhl, A. I. E. E. and E. W. Pratt. Size 6x9; 672 pages; 648 illustrations. Geo. A. Zeller, St. Louis, Mo. Price, $3.50. The increasing number of men employed along steam and electrical engineering lines creates a demand for an up-to-date authority on these subjects, a work at once simple in expression and practical. Spangenberg's Steam and Electrical Engineering is designed to fulfil this want and it not only covers the ground thoroughly, but also contains over 100 questions and answers exhausting the details of the subject. Repair work which so often is the crucial test of the master mechanic is carefully treated in this work, as is also mechanical refrigeration. It contains an interesting chapter on Hydraulic Elevators and another on Compressed Air. The arrangement of the book is well adapted for ready reference.

UPRIGHT DRILLS. An extremely valuable and interesting pamphlet has been issued by W. F. and John Barnes, 100 Ruby street, Rockford, Ill. A free copy will be sent to readers of this magazine on request.

HINTS TO INVENTORS.

Here's a practical money-making opportunity for some inventor. There is a positive demand for an inexpensive eye-guard which can be worn by children and others engaged in setting off firecrackers and other fireworks. With the eyes thus protected the small boy could be turned loose to inflict what damage he pleased to other parts of his anatomy.

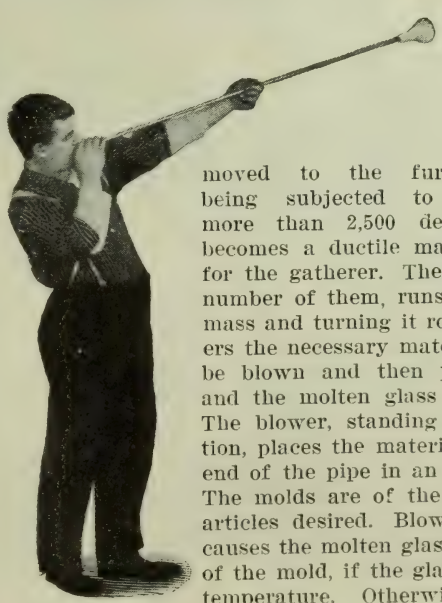
Popular Mechanics

Vol. 6. No. 8. CHICAGO, AUGUST, 1904. 10 Cents a copy. $1.00 a year.

How Cut Glass is Made

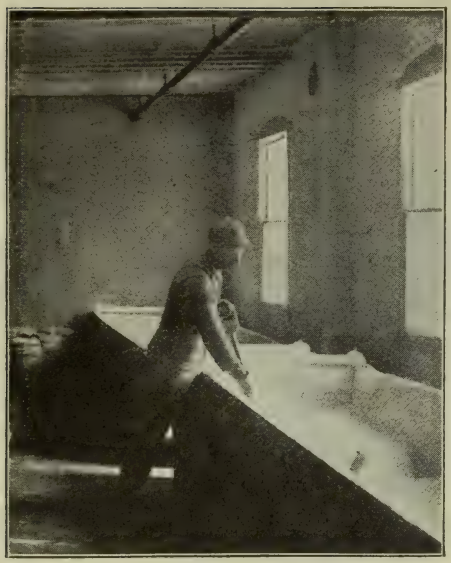
American Product Rivals That of Europe--Its Perfection Depends Upon the Skill of the Workman and Secrets Which are Carefully Guarded

In Russia and in the Berkshire Hills of the United States there is found a sand peculiarly adapted to the making of the most beautiful of all glass products—cut glass. White as flour and almost as fine it is shipped from Massachusetts in car loads. The industry to which this silica sand contributes is among the most interesting in the United States, and the workers who engage in it hold an unique place among American craftsmen. A day at a cut glass-making center, witnessing the marvelous skill of the workmen and the various processes from the molten mass to the finished product, is a day of education and profit, well worth while.



The sand from the Berkshire Hills having reached its destination, it is mixed in large vats or bins with such other minerals as potash, red lead and saltpeter. In the mixing of the sand and the other necessary minerals there is a secret which is carefully guarded, for it is in this initial operation that the real quality of the glass is determined and on this that its ultimate beauty depends.

When mixed properly the "batch," as it is called, is removed to the furnaces where, upon being subjected to a temperature of more than 2,500 degrees Fahrenheit, it becomes a ductile mass and is soon ready for the gatherer. The gatherer, there are a number of them, runs a long pipe into the mass and turning it round and round, gathers the necessary material for the article to be blown and then passes both the pipe and the molten glass upon it to a blower. The blower, standing upon a slight elevation, places the material gathered about the end of the pipe in an iron mold at his feet. The molds are of the shape of the various articles desired. Blowing through the pipe causes the molten glass to assume the shape of the mold, if the glass is at just the right temperature. Otherwise, it is placed in

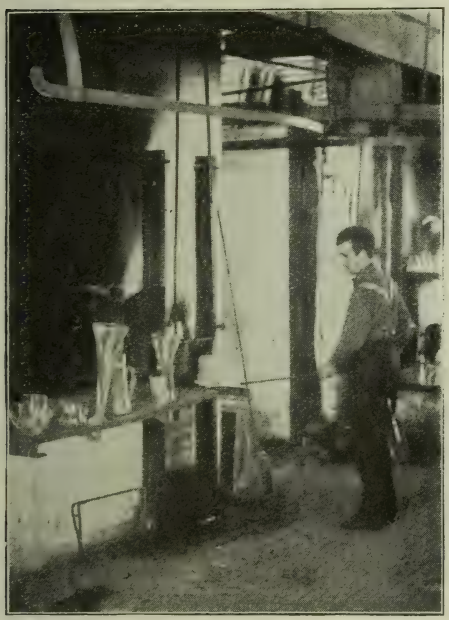


The Sand from the Berkshire Hills is Mixed in Large Vats or Bins with Such Other Minerals as Potash, Red Lead and Saltpeter.

A Workman Outlining Designs on Wine Glasses. Some of the Prettiest Designs in Cut Glass Have Come from the Workmen.

A General View of the Cutting Room

what is known as a "glory hole" by a helper for reheating. The molds referred to are only used in blowing certain kinds of articles. Other shapes are obtained by skilful rolling of the molten glass gathered about the pipe upon a smooth surface, the workman also having in hand a pair of compasses which assist him in attaining accuracy of shape and size. All these processes produce the blank. When this blank is properly cooled it is ready for the designers and the cutters. The cooling process consists in slowly moving the blanks from the front of an oven to the rear, the cooling



Ready to Place the Blanks in the Ovens

very often requiring a day or two. The front portion of the oven is, of course, kept very hot while the rear is comparatively cold. Many of the great factories which perform the cutting and finishing operations do not make these blanks, but buy them from factories which do make them.

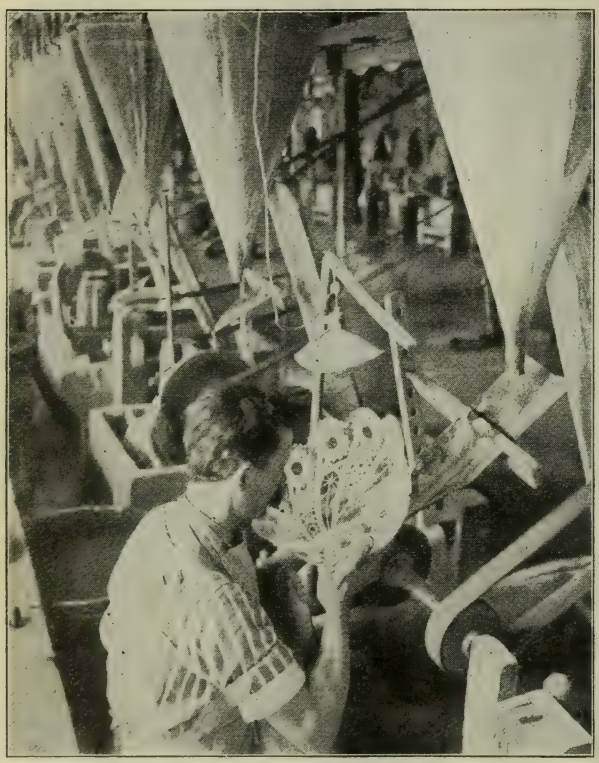
The skilled workmen in the blank-making departments receive the highest wages, higher in most instances than those known as strictly cut-glass workmen. Two men, whom we witnessed at work among the blowers, make $7 and $7.50 per day, respectively. One of them had been thus employed

A Smoother at Work

for 35 years and his son was working at the same trade. It is in this department of glass manufacture, however, that the latest machinery will make noticeable

Accurately Shaping the Article by Means of Compasses

inroads. These men who make big wages in producing glass are usually a very desirable class of citizens. The standard of intelligence in all lines of the glass industry, we are told, has been raised immeasurably during the past 10 years. While these men spend money freely, still they are becoming home builders. In Toledo, O., where the glass interests have long been among the largest industries of the city, it is said that more people own their own homes than in any other city in the United States. At Alexandria, Ind., which has for years been the center of large glass-working interests, it is said that the average glass worker gives his wife $20 a week for the expenses of the house. Alexandria is one of the places where machines have been introduced to take the place of many skilled workmen.



A Skilled Glass Cutter at Work on a $300 Punch Bowl

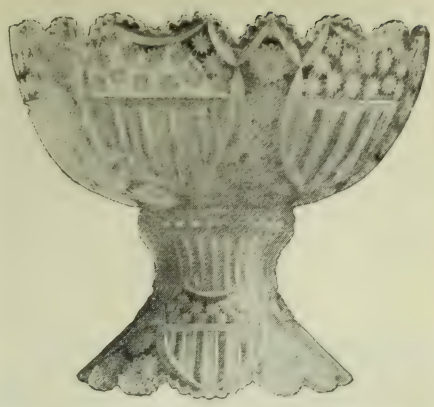
But to return to the making of a cut-glass article, when the blanks are ready for the subsequent operations the various designs for the cutters are marked upon them with red lead. Prizes are sometimes offered workmen for new designs and some of the prettiest designs in cut glass have come from the workmen themselves.

As heretofore stated, the cut-glass worker holds an interesting place among American craftsmen. He is one of less than 2,500 engaged in his occupation, there being 1,200 to 1,400 organized cut glass workers in the United States, while those not organized are roughly estimated at from 800 to 1,000. These figures do not include the blowers and helpers who make the blanks. It has been estimated by one prominent manufacturer that the cost of a complete cut glass article, blank and all, in wages is nearly 60 per cent of its value.

The glass cutters sit side by side at wheels. In funnel-like arrangements overhead there is a mixture of sand and water which is fed to the wheels as the cutting progresses. The first operation in cutting the designs is called "roughing," and this is done upon a steel wheel. The article to be cut is held against this wheel which wears its way to the desired depth. To know just how deep to cut is one of the chief tests of the cutter's skill. At almost any stage of the cutting operations a very expensive piece of glass may be ruined by an inexperienced hand. It is no wonder, then, that five years' experience as an apprentice are required. One of the photographs shows a skilled workman roughing a punch bowl, which, when completed, will sell for a sum in the neighborhood of $300.

From the "rougher" the piece of cut glass passes to the "smoother," who also works at a wheel. In this instance it is a stone wheel, the stone being imported from Europe. This wheel and its operator add a certain smoothness to the work that is essential before it goes to the polisher. The polisher with pumice stone and wheel of wood gives the finishing touches. After the articles have been finished and washed they go to the packing and shipping departments, and from there are sent out to all parts of the world.

Another of the photographs pictures the punch bowl which was presented to the late President McKinley and which is said to have been the largest cut glass punch bowl ever made. It required two expert glass cutters nearly four weeks to make this bowl. It is in two pieces and weighs 75 pounds. The color is perfect. America to-day excels in the production of cut glass. In fact, it was a Toledo company that brought the art to its present high standard of beauty. Other American factories now produce beautiful cut glass articles, however, and wherever these have been exhibited in competition with the product of foreign countries, they have excelled in scintillating radiance, in crystalline clearness and in richness of design.



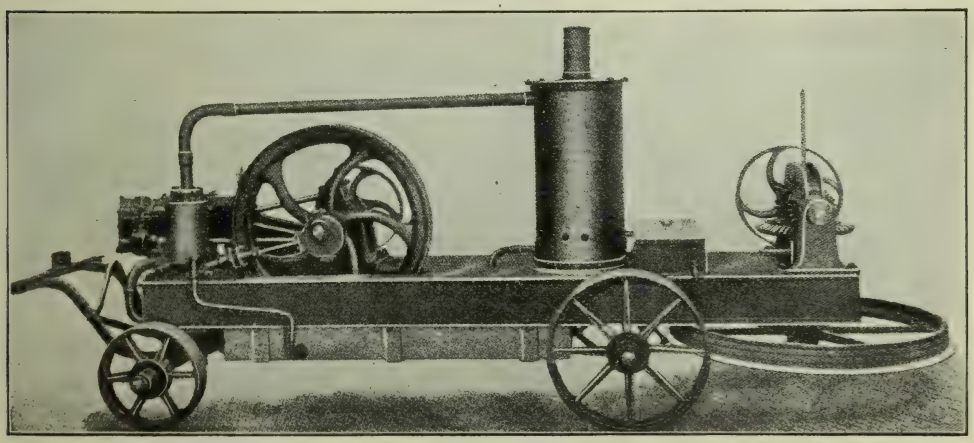
The Cut Glass Punch Bowl Presented to President McKinley

Portable Stone-Cutting Machine

A portable stone-cutting machine, deriving its power from a gasoline engine, is in successful operation in a large quarry in England, and is proving a great labor saver, thus saving money, too.

This apparatus is designed to cut rocks or boulders in their natural position by means of an endless steel wire cutting in both inward and outward directions. The cutting medium used is water and finely-ground quartz contained in separate vessels, but fed together in a trough, with a spout terminating directly over the cutting wire where it enters the rock.

To obtain a vertical cut in the rock where the cutting wire is running at an angle, it is necessary to employ what are termed rock guides, the function of which is to guide the wire round the corners of the block to be cut out. The guides consist of center spindles, 2 inches in diameter, which revolve on centers, over which weighted sleeves slide. A 3-inch hole is first cut down with a jumper drill, the rock guide being inserted in this hole and stayed in position at its outer end by wire ropes securely fastened by pegs into the rock. The cutting wire is then led round the spindles, one at each corner, and is fed down into the rock by means of the weighted sleeves.

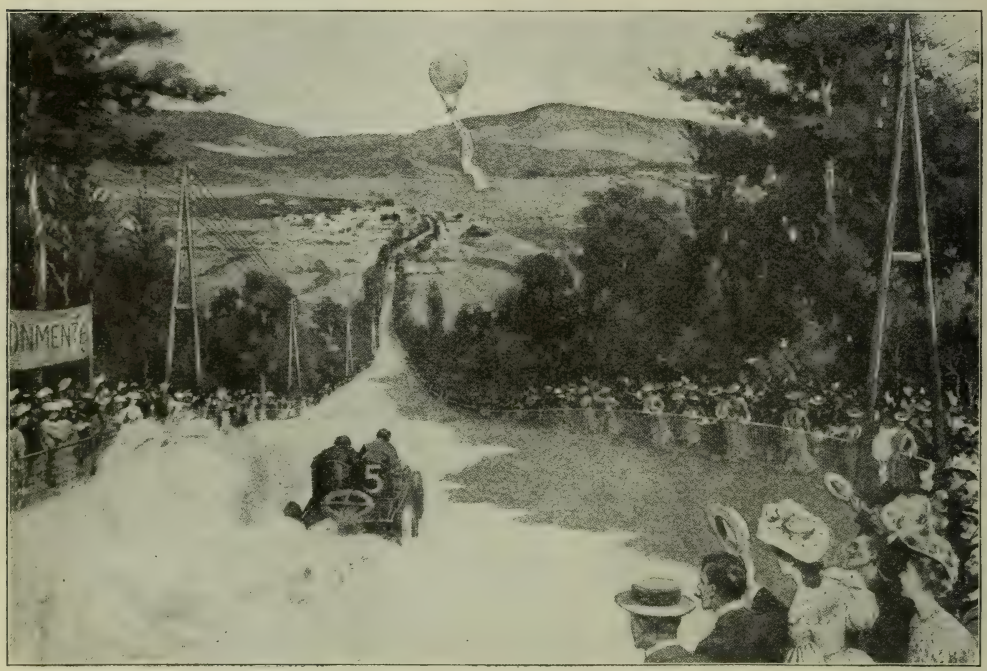


An English Portable Stone-Cutting Machine

France Wins in the Automobile Cup Race

France now holds the international trophy which gives her automobile industry foremost rank in the world. This is the third time France has held the trophy since the international contest was first instituted in 1899 by James Gordon Bennett of New York. England held it once and last year it was won by Germany.

As the prize is always defended in the



View of the Course from the Saalburg--Captive Balloon Hanging Over It.

land where it is held the race course was laid in Germany in the neighborhood of Saalburg, where the start and finish took place between two huge grandstands on either side of the road. Each of these grandstands accommodated 2,500 people and were connected by a tunnel under the roadway. Seats were sold at $12.50 each. Ten telegraph and three wireless telegraph stations were installed to dispense news of the progress of the race.

Two other official stands were erected at other points on the course, while different parties erected stands at various other points along the course, though these had no telephone connection. Near the grandstands the roads were sprinkled with Westrumite to lay the dust. Cross roads along the course were closed at an early hour and along the entire distance of about 85½ miles men were stationed about 20 rods apart. To make the race the required length the course must be covered four times, about 342 miles in all.

The contestants represented seven nations, Austria, Belgium, France, England, Germany, Switzerland and Italy, each entering three cars. At an early hour the crowds began to gather, coming by every means available, by carriages, automobiles, motorcycles, on foot, by trolley cars or steam. At 6:20 the Emperor and Empress and many other members of German nobility arrived and German patriotism ran high.

The race began promptly at 7 o'clock, the cars starting at intervals of seven minutes, each start signaled by a bugler, who stood with a trumpet at his lips, his cheeks puffed out and his eyes watching the wheels for their first revolution. The cars of each nation were painted in a color by which they might be distinguished from the others as they careened past the grandstand. After

all the contestants had made their start, which took some time, there were long intervals between the flashes of color as they whirled past. These intervals were relieved by music and refreshments for which ample provision had been made for the great crowd. From the first the interest centered in Thery of France, Jenatzy and De Caters of Germany. The other cars were all hindered more or less by defects which developed at the last moment. Thery, driving a Georges Richard-Brazier car, finished the four rounds in 5 hours, 50 minutes and 3 seconds, just 11¼ minutes less time than Jenatzy who drove a Mercedes car and whose time was 6 hours, 1 minute and 28 seconds. Baron de Caters came out third, 45 minutes and 10 seconds behind Jenatzy.

France had won the trophy, but the event was marked by the heartiest good will on the part of Jenatzy, the German, who won last year.

The "General Slocum" Disaster

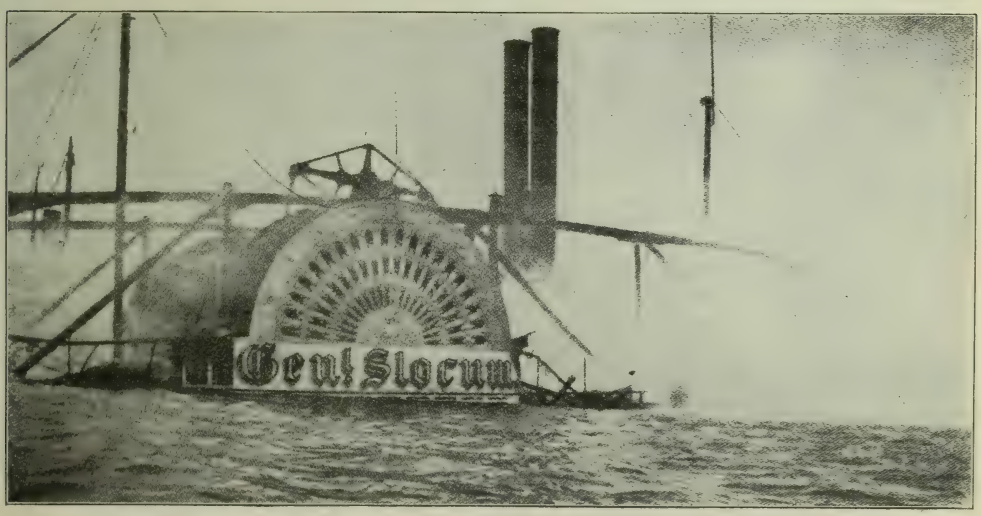
In the wake of the "General Slocum" disaster of June 15, in which over 900 persons, mostly women and children, lost their lives, comes a discussion by the press of the country as to the best means of avoiding such horrors in the future. That criminal carelessness existed somewhere was evident on examination of the rotten life-preservers to which many of the ill-fated passengers trusted themselves. These were shown to be filled with crumbling cork and glue and they sank with their precious burdens when they reached the water. Hose which burst at the first attempts to use it; lifeboats securely wired so that they could not be lowered; confusion among the crew who were untrained for such an emergency, having had no fire drill whatever, and a long run upon the waters with the flames raging every moment more fiercely and shrieking women and children falling into the hold which had become a fiery furnace, or else leaping into the water to meet a slightly less horrible death; these are some of the stories told by the few hapless survivors.

Marine papers agree that excursion boats can be made safe from fire and some of them forecast what the future construction will be. The American Siren and Shipping says:

"There is no reason why the superstructure of one of these craft should not be almost wholly fireproof. Light steel could take the place of wood in nearly every particular, and the asbestos coverings now available are a protection which it is almost criminal not to use. There is no reason, either, why every deck of such craft should not be divisible by fireproof sliding doors or asbestos curtains to prevent or at least retard the sweeping of flames from one end of the vessel to the other. These are things which must come in time, just as certainly as the theaters have been safeguarded."

The Marine Journal coincides with this view in several particulars. It says:

"As a safeguard against fire on steamboats there are many improvements that



The Excursion Boat which Carried Almost a Thousand to Doom

can be made that would not work too great a hardship on owners having boats in the business. For instance, there could be asbestos curtains fitted in two cross sections at least on each deck, which would confine the fire to the part of the boat where it might originate. Instead of hose being reeled up it could be stretched and held in brackets or beckets ready for immediate use. Added to this, the use of fire-proof paint and two reliable men at least on each deck to patrol it, watch out for fire and do nothing else, would reduce the danger on boats now in commission. While in wooden boats to be built steel bulkheads should incase the machinery to the upper deck, iron deck frames and carlins and steel tube stanchions should be fitted throughout. In fact, wherever metal could be used to advantage and not make the boat cost a prohibitive price for the business it is built for, it should be employed. Add to these precautions, eternal vigilance, and every excursion boat will be as safe as one's home."

THE RATE WAR BETWEEN ATLANTIC STEAMSHIP LINES.

In the great rate war which has been raging between German steamship lines and the Cunard line, while the evil influence extended wide on every hand, the United States was the chief victim.

So frantic were the opposing factions in the endeavor to outdo each other in the cutting of steerage fares that the rate was reduced from $20 and $30 to $8.75 per head.

While the laws of the United States regarding emigrants, their physical, mental, moral and financial condition and abilities are, if possible, more rigidly enforced than ever before, the low rate removed the chief protection of a country which, while she has ever befriended the emigrant, still excludes those who would sap her vitality. The higher rate brought in the main those who had the energy and purpose to persist until the sum required was saved, thus proving themselves in the mere endeavor. With the rates less than $10 from London to New York the off-scourings of the earth might take advantage of them and such emigrants are not wanted here.

England became anxious as to the effect on Canadian emigration as many points in Canada could be reached more cheaply by way of New York than by Quebec. The losses, it seems, will fall more heavily on the German lines as they depend more on their passenger traffic than does Great Britain.

Emigrants Boarding an Ocean Greyhound at Queenstown

Mechanical Features of the War

The gaping astonishment with which the world has followed the movements of the Japanese forces in the Far East has now settled into the hush of expectancy while it awaits the outcome of the approaching crisis. Within the last month the wonderfully planned and admirably executed Japanese campaign has been completely carried out, and now there remains to be seen what the congested forces in the vicinity of Port Arthur and Mukden will do.

For years to come the world that has watched the daring advance of the little oriental fellows they believed to be so far behind the times will tell how its eyes were opened.

Brief sentences occurring now and then in all the press reports reveal one of the secrets of the Japanese's remarkable success. At the Yalu it was a finely planned system of pontoon bridges; at Telissu it was batteries connected by telephone; in a naval engagement it was wireless telegraphy communication with a scout ship; and recently a war balloon was successfully used. These things show how adaptable the Japanese is to modern conditions.

The Russians are strengthening Port Arthur by every means possible. Around the Russian stronghold they have erected miles of barbed wire entanglements and within these are the fortifications. The struggle will be Titanic.

Russians Constructing Barbed Wire Entanglements Around Port Arthur

At this time no Jap remembers his individuality; with brave hearts, mothers and wives and daughters take leave of their dear ones, praying, not so much for their safe return, as for the success of their

cause. We are told that the men of Osaka, Japan's great commercial city, for a quarter of a century have borne the brand of cowards, so that no Osaka man was deemed worthy of even the least of service medals, and yet at the battle of Nanshan which ranks the Japanese with the foremost military powers, it was the Osaka division that, when the day seemed lost, charged up the heights and, planting the flag on the hilltop, inspired the fagged-out forces on to victory.

When, from the home port the Japanese troops embark for the scene of the war, from every hand the people lift up their resounding cheers. Flags are unfurled and

But once have the heavy clouds which overhang Russia lifted, and even then though she succeeded in sinking one Japanese vessel and disabling two others, with a loss to Japan of about 1,000 men, the move is generally considered to have been of no strategical importance. Admiral Skrydloff, the commander of the Vladivostok squadron which made the successful raid in the Korean straits, is a man of imposing personality, and to him the Russians look with admiration and renewed hope. The illustration shows him standing on the bridge of his flagship.

The only great disaster that has overtaken Japan during the entire course of the

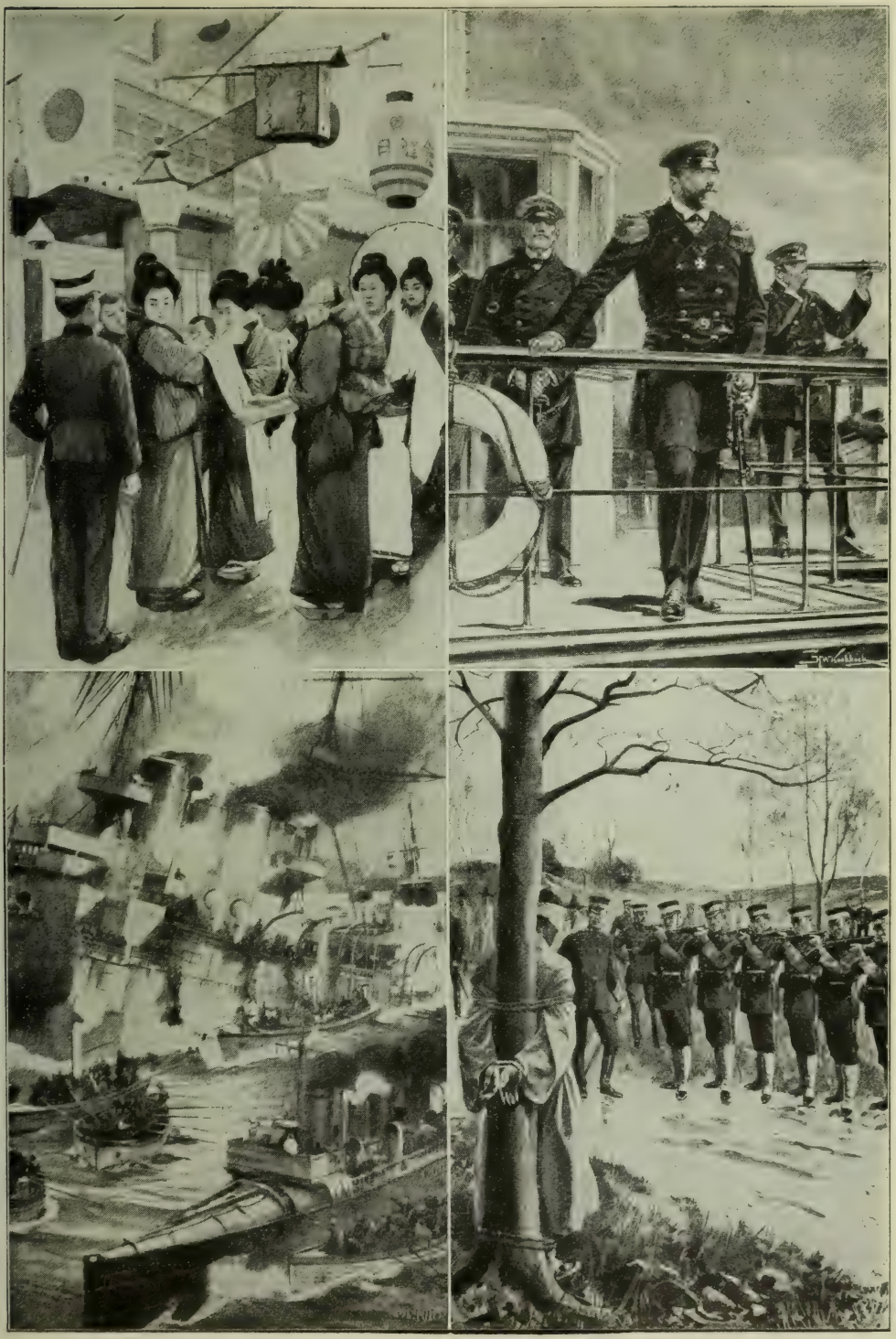
Japanese Embarking at Nagasaki for the Scene of the War

the scene with all its oriental trappings is most picturesque.

One of the strangest of Japanese customs is the stitching of a safety girdle which is supposed to charm the life of the soldier who is so fortunate as to possess one. A woman who has someone in the war passes along the street carrying a long narrow piece of cotton stuff on which there are a thousand black dots. As she goes she requests different women to put a few stitches in the girdle, until at last a thousand women have each passed a thread through one of the thousand dots. Sometimes a number of women will gather around one who has a dotted cloth.

war, was the destruction of the battleship "Hatsuse" by a mine nine miles off Port Arthur. All the nations have condemned Russia's action in strewing the high seas with floating mines. The "Hatsuse" was of 15,000 tons displacement and cost over a million dollars. With her were lost 431 men, while 82 were injured, among them being a number of officers.

Summary punishment is meted out by the Japanese troops to Russian spies. Martial law governs the case and the decision and punishment are speedy. The illustration shows a Japanese soldier shooting a Korean spy who had given information to the Russians.



The Safety Girdle
Destruction of the "Hatsuse"

General SKrydloff
"Death to the Spy"

Russia's fleets, although they have made a far better showing than her land forces, have been singularly unfortunate. They have barely been able to withstand the repeated attacks on Port Arthur by the Japanese vessels and have met heavy reverses at all times. One of the singular facts has been that her greatest losses have come from disheartening accidents resulting from causes in her own control. Whether this signifies that she is careless or ignorant the watching nations are puzzled to decide.

Mounting the Guns of the New Baltic Squadron

Now she is rushing the new Baltic squadron to completion and the scenes at the Nevsky, the Baltic and the new Admiralty shipbuilding yards, where the work is being carried on day and night, are scenes of great activity. Mighty cranes are used to lift the heavy 12-inch guns into place, while smaller guns are mounted by means of temporary derricks. The yards are located in the Neva river near St. Petersburg.

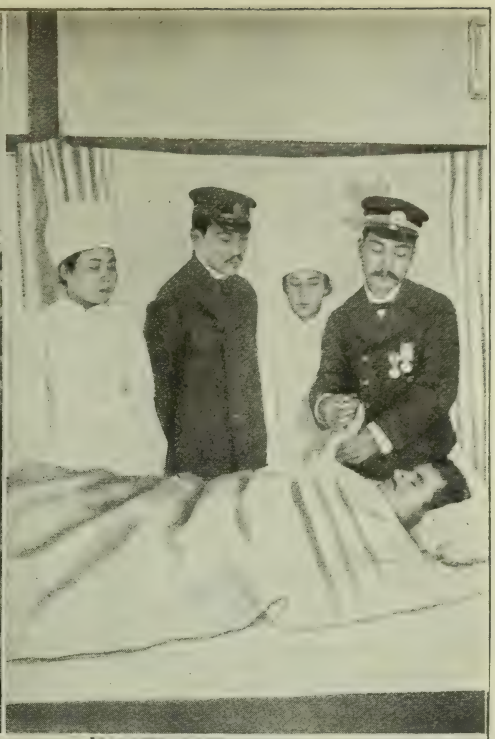
One of the most daring and terrible charges was made with lances during the fight at Wafangtien by the Fourth and Sixth Companies of the Eighth Siberian Cossacks upon the Japanese cavalry. The mad rush made by the big fellows was not to be repulsed. The terrible weapons were thrust into men and horses; some of them stuck and could not be removed. An entire Japanese squadron was literally cut to pieces and when the Cossacks lost their lances in the fray, they seized the swords from wounded Japs and continued the fight.

While the Russians have many times shown gross brutality and have even mutilated the dead bodies of the enemy, rumors of such atrocities on the part of the Japanese have been very few. Russians who scoff at the Japanese soldier, however, are loud in the praise of the Japanese hospitals.

The work of the Japanese medical corps is carried on regardless of nationality, and many a wounded Russian has had the tenderest of care from the despised enemy. In many instances the food the Russians have been accustomed to has been afforded the patients. The Red Cross Society ship of the Japanese is splendidly equipped, and the women nurses are the equal of any in the world.

Before the Japanese make an important move they are fully informed of the lay of

The Cossacks Use Lances



Japanese Nurse Wounded Foes

Japanese Spies in Korea

Bandits Burn Telegraph Poles

the land before them by spies, of which they have a wonderful system. These spies note every detail and gather an incredible amount of information. Thus prepared the officers can command an advance with something of a certainty as to the conditions to be met.

The Chunchuses, Chinese bandits, are aiding the Japanese greatly. They are constantly harassing General Kuropatkin's forces and are retarding Russian movements in many ways. One of the great annoyances they delight in is twining telegraph posts with straw and setting them on fire.

Japanese outposts are extremely vigilant and are often accompanied by a dog which quickly scents the messenger stealing along so cautiously. Anyone the Japs catch stealing along the shore is immediately shot.

Russian officials are doing all in their power to make the war more popular among the people. Restlessness and grief pervade the empire and the poor peasants have little hope left when they have sent the strongest and best of their men to almost certain death.

Prints putting Russia in the most favorable light are being distributed throughout

Running the Gantlet--A Convict's Chance for Liberty

Liberty the reward for success;
Death the penalty for failure.

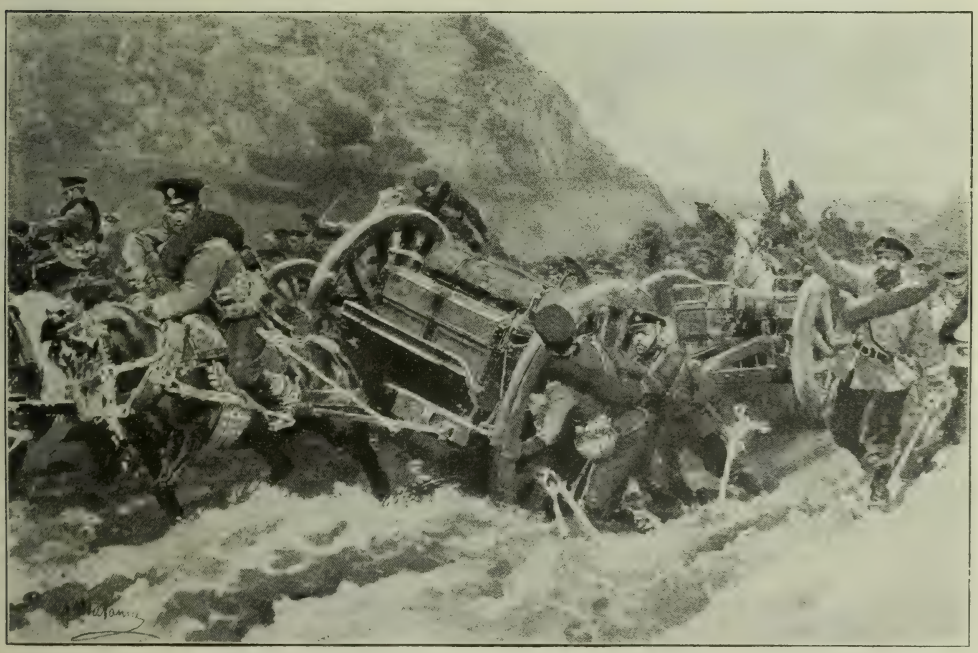
These are the alternatives offered one Russian convict each day at Port Arthur. Once in every 24 hours a courier is sent out in the effort to penetrate the Japanese lines and carry news to Kuropatkin of conditions in the beleaguered city. So alert are the Japs that only an occasional carrier gets through with his letters, written in cipher, and wins his reward in liberty, of which he had had little hope.

Much of the journey the poor wretches must make at night, for there are some points so dangerous that few escape. The

the country to give the impression that hers is the victorious army.

Two of these prints are shown here. One represents Russia as the spirit of peace, a dove with an olive branch resting on her uplifted hand, while in the other she holds a lily. Behind her stalks Japan in the garb of a fiend of darkness, bearing a knife and attended by the monsters of the deep. The other shows a group of Japanese officers before whom the spirit of the great Napoleon has just appeared. Consternation and horror are depicted on the officers' faces as the spirit says, "If my thunderbolt against Russia failed, what can

Prints the Russian Officials are Distributing Among the Peasants in the Effort to Make the War More Popular



The Hardships of the Russian Transport in Manchuria

yellow-faced dwarfs like you expect?" These prints are believed to have an appreciable effect on the minds of the people. Another stroke of policy in this line has just been made by the Czar in granting all persons suspected of conspiracy against the government, and the political prisoners, a right to trial the same as in other offenses, instead of, as formerly, banishing them to Siberia without trial. This sweeping reform will mean a great deal to the Russians and is apt to make them more kindly-disposed toward the ruling powers.

The Cossacks are extremely superstitious. Not one of them would antagonize the will all these things the Russian spirit much do battle—but he can turn a ready mind to devotional services.

When a trainload of soldiers stop at a town at the close of the day, on leaving the train they line up beside it, the bugles sound, and then with bared heads they stand while a priest reads the evening prayers. After this service their courage is further revived by singing popular Russian songs.

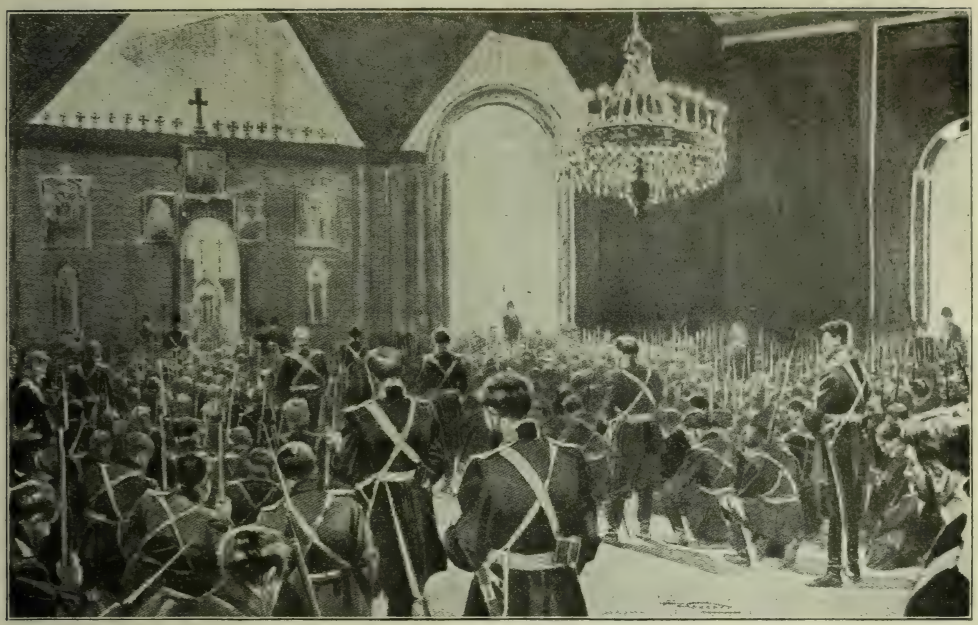
The illustration shows Russian soldiers worshiping in the church at the great city of Harbin. The military effect of the many bayonet points rising above the bowed and

"Over the Restless Battalion Falls a Great Hush While the Priest Offers a Prayer"

of a priest for whom they entertain a great awe. Just before going into action a strange scene is enacted by the army so soon to go forth to fight and kill. A priest bearing a cross rides out before the troops. In an instant every head is bared and bowed, and over the restless battalion falls a great hush while the priest offers the prayer.

Wherever he is seen, boarding the train for the front, marching across the frozen expanses, on board a battleship or stopping of nights at cities while en route for the war, the Russian soldier is always devout. No conditions so uncomfortable, no place so cold, no landscape so dreary—and with kneeling figures makes the scene remarkable in the extreme, and is significant of the nation's attitude toward its own religion.

The breaking up of the cold weather brought greater difficulties for the Russian soldier to contend with. He was accustomed to the cold so that it was not a great hardship, but the deep mud which came with spring handicaps him at every turn. The roads in Manchuria are poorly constructed and the heavily loaded transport wagons sink hub-deep. To move a battery of artillery forward means a terrible struggle for both men and beasts and leaves them in a thoroughly exhausted condition.



Russian Soldiers on the Way to the Front Worshiping in the Church at Harbin. Even in the Poorest Districts of Russia, where the Peasants Live in Wretched Hovels, Beautiful and Costly Places of Worship are Erected

A Brave Charge up the Heights

In the fight which has been raging among the hills around Port Arthur the Japanese have made many brave charges up the steep heights. The Russians entrenched at the top of the hill have all the advantages of locality and only by great loss can the Japanese hope to dislodge them. Never faltering at the terrible prospect, with shells falling thick and fast among them and always advancing over the dead and wounded bodies of their comrades who have gone before, they have persisted until the heights were scaled and the enemy put to rout. Many pieces of Russian artillery have been captured after such a struggle.

DISASTER BEFALLS RUSSIA'S FINEST SUBMARINE BOAT.

With the carnage of war pressing closer around her, with bloodshed and losses and famine and defeat confronting her troops on every hand, on the peaceful river Neva, where the red fringes of the war have not yet reached, Russia has just beheld one of the worst tragedies the present war has brought her. In all previous history there has been but one like instance with the difference in that instance that none lived to tell the story, while in this a few survive who will remember the horror of that time all their lives.

The scene was in the Neva river where, just off the Baltic ship-building yards, lay moored the "Delfin," the finest submarine boat in Russia's navy. A detail of raw sailors and officers had trooped down to the wharf to learn something of the management of the deadly little craft which now figures so greatly in the fates of nations. Though far removed from the scene of the war, the atmosphere was thrilled with something of the spirit of that bloody conflict. The men were eager to board the boat, but the three officers hesitated; the captain was absent. The crew was experienced, however, and desire finally conquered any misgivings.

Laughing and jesting 32 men descended into the boat, though the "Delfin's" capacity was for but 10. As the last man entered a passing tug sent a great wave of water splashing into the interior. The inexperienced sailors were thrown into a panic. Already the submerging apartment was open and the crew were screwing down the manholes. One sailor made a desperate effort to escape and there was a rush of escaping air, a number of flying bodies hurled violently out through the manhole, and then, like a stone, to the river's bed sank the "Delfin," and with her went 21 men, 11 having been blown through the manhole and escaped with their lives! One of the officers who was thus saved, afterwards said:

"I remember a sickening sense of suffocation from the fumes of the storage batteries and then a rush of air and water; a flash of blinding light, and the next thing I knew was that I was ashore. What those who sank with her suffered I dare not think."

The "Delfin" was raised shortly afterwards.

THE GREAT ELIZABETH SUSPENSION BRIDGE, BUDAPEST.

After six years of incessant labor the great Elizabeth suspension bridge, crossing the Danube at Budapest, is opened to the public. There were no physical conditions which made the suspension type a necessity, and this style of construction was chosen chiefly on account of its symmetry and beauty. A short distance down the river is the old chain suspension bridge, the Lancz; while on the other side is Ferencz-Jozsef, a cantilever built to resemble a suspension bridge. The Elizabeth is 951 feet long in the main span, and of unusual strength. It carries a double track electric railway, and also has passageways for teams and pedestrians. The structural materials were produced at the government steel works, and the shops of the Hungarian State Railways. Only a few small details such as lamps and ornamental railings were furnished by private firms. The erection was by the Danube Bridge Department.

In England one must not leave his automobile with engine running, unattended in a street or public place. Violation of this rule is punished with arrest and fine.

Paris surgeons are using the cinematograph, or moving picture machine, for demonstrating to students the method of proceeding with typical surgical operations.

United States citizens drank 10 per cent more liquor in 1903 than 1902, or 3,623,913,194 gallons of stimulating drinks at a cost of $1,451,533,379.

Electrical Mosquito Destroying Apparatus

Insects Lured to Death by Sounds of Music

The introduction of petroleum oils for covering the surfaces of waters in low, marshy places where mosquitoes breed, promises to be superseded in some countries by systems of destroying the pests with electrically designed and driven contrivances. In the tropical countries this work, under the management of interested parties, has been carried on for a number of years and is steadily progressing.

Petroleum oil has been extensively utilized for the purpose of coating the waterways with a film of oil, as its odor tends to destroy the existence of the mosquito; but for various reasons, oils on the waters are not practicable in many instances. Other means have been devised. Smoke producing apparatus was utilized in some places and

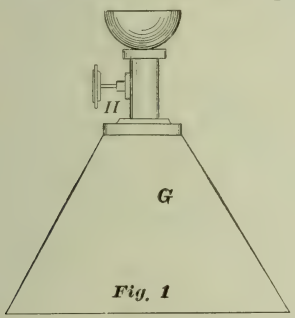


Fig. 1

the volumes of sulphur-laden smoke destroyed insect life within a certain radius; poisons of various kinds have likewise been employed in the science of mosquito destruction, and now up-to-date models of electrical devices have been designed both in America and foreign countries and employed for the purpose of destroying mosquito life in the lowlands, along the river banks, and in fact wherever the pest thrives. Fig. 1 gives a general idea of one of these devices.

What looks like a big lamp shade is made of sheet metal, painted white inside, black outside. The diameter at the lower edge is something like 3 feet. The shade tapers up to G and is connected to the electrical portions at H. In order to get an idea of the workings of the death-dealing affair, reference should be made to Fig. 2, where is shown the little magnetic coils I, I. This ponderous lamp shade, so called, is set up in proper contrivances on pole connection in pools, swamps, yards, or places where there are enough mosquitoes, and the proper electrical connections are made with the coil wires. The coils are about 1000 ohms resistance, with a vibrator, J, between their poles. A lightning globe is inserted at the

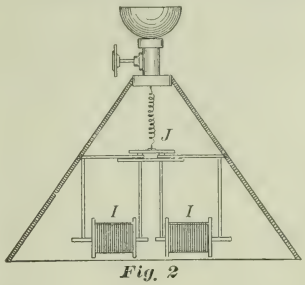


Fig. 2

upper portion of the shade and the bright light against the whitened surfaces is reflected strongly and attracts the unwary mosquito to his doom. The candlepower of the light is about 30. Another feature of the device is the erection of some fine wires inside the shade, arranged on the harp plan. These wires are caused to vibrate just enough to emit musical sounds. The music is soft, but it floats on the atmosphere for considerable distance on clear nights.

The buzzing sounds are very like that from the mosquito himself and the soft, enchanting music draws thousands of insects to the shade. Inside the shade a sticky surface, usually made of fly-paper, is arranged. Sometimes, instead of gummed fly-paper, portions of metallic surfaces are coated with a sticky composition on which the mosquito is pretty sure to fasten himself by legs or wings while wabbling about

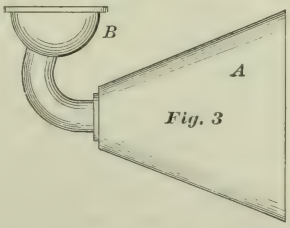


Fig. 3

with eyes dimmed by the strong light and with mind benumbed with the sweet strains of the harp cords. The result is that multitudes of the insects lose their lives in the shade and either remain therein, to be scraped out next morning by cleaners, or to

drop down to the earth of their own weight when dead. Underneath the device one sees numerous mosquito dead. The music attracts and stuns and causes death oftentimes. Some of the makers of the paralyz-

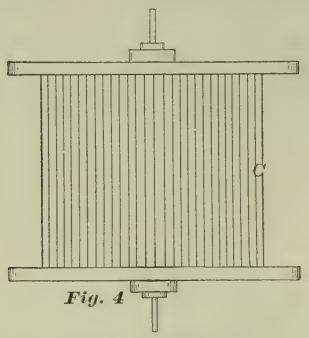


Fig. 4

ing devices use the shades in the manner exhibited in Fig. 3. The shade itself is designated A, and the connecting cup with the wiring is marked B. The construction of the musical sound-producing mechanism is shown in Fig. 4. It is made of a metallic frame across which is strung the set of fine steel wires C. The vibrations of these wires in mid-air, even if caused only by the drafts of wind blowing through, send forth an entrancing music that seems to attract the mosquito to the trap.

One of the oddest types of mosquito destroying contrivances lately devised is one in which the mosquitoes are sucked into the death trap, shown in Fig. 5. There is a cone-shaped tunnel made of wood, about 4 feet in diameter at the open end, tapering to about 3 feet at the base end, where the suction propeller is operated. The length of the cone tunnel is about 4½ feet. It is set up in places where mosquitoes congregate in

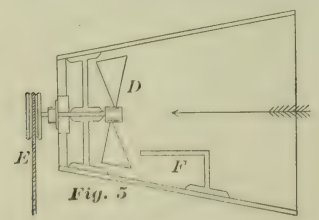


Fig. 5

numbers to breed. The propeller D is a suction wheel and so arranged that any light object like a mosquito coming near the open end of the cone is promptly sucked into the death-trap. The wheel is speedily revolved by the belt E on a wooden grooved wheel. The belt is operated by a motor below. This contrivance is fixed to a post at about the elevation of ordinary tree tops; F is a stand on which is placed poisonous material, the fumes of which rise into the nostrils of the mosquitoes which are so unluckly as to be drawn into the tunnel by the air suction. Soon after starting the affair, the mosquitoes accumulate and before the next morning the machine has, as a rule, piled the mosquito dead to a goodly height.

A SUGGESTION FOR PHOTOGRAPHERS.

Here is a method of timing exposures which is far more accurate than counting, which always varies in the time it takes with the individual who is doing it, and therefore cannot have a standard time value.

If the exposure is for one second, say "Naught, one half and one"; if for two seconds, say the same twice; if for a half-second, say "Naught, one-half" as rapidly as may be, and for a quarter-second, merely say "Quarter." It is almost impossible to say these words too quickly.

BABY INCUBATOR AT THE FAIR.

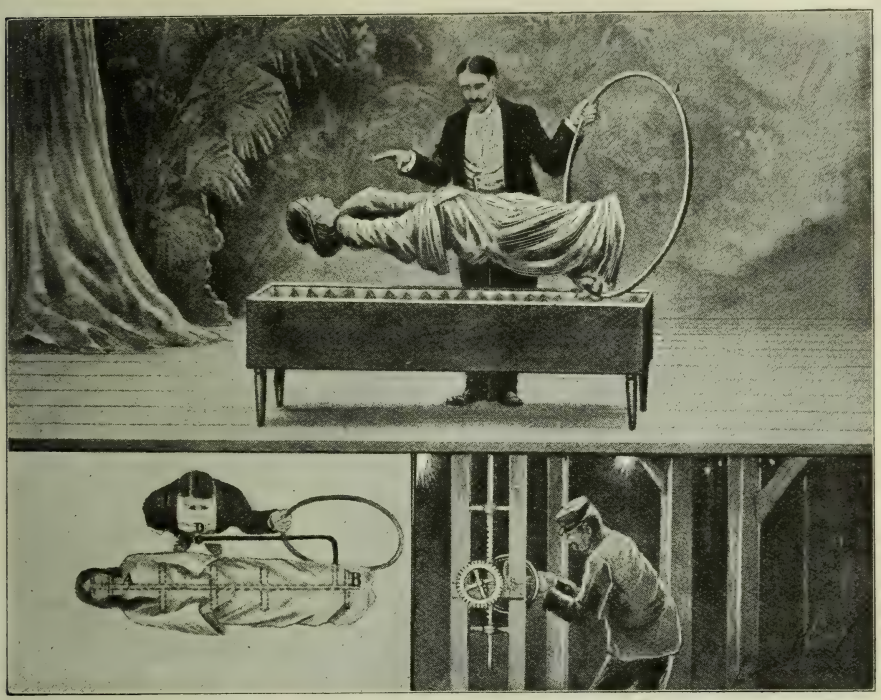
One of the most interesting exhibits at the St. Louis World's Fair is a baby incubator fully equipped, not only with all the apparatus and accessories necessary, but also with the frail, little new-born being whose chance for life is depending almost entirely on the care received through the incubator. A great many elements enter into the construction of a reliable incubator for nurturing human life. Not only must the temperature be kept at a certain degree, but sanitation, air and means of feeding all require a great deal of careful attention.

AN IMPROVEMENT FOR DYEING MACHINERY.

A German has just produced an invention which will work a radical change in dyeing machinery. In the method of dyeing in present use the goods pass at full width through a part called the jigger which contains the coloring liquid. The new invention does away with the reservoirs for mixing the dye and it is mixed in the vat instead, and then sprayed with great force upon the cloth by means of atomizers.

Mysterious Mechanical Stage Illusion

How a Seemingly Impossible Feat Is Performed



"Without Any Apparent Support, She Remains in the Air"

Theater goers in Europe are being puzzled over an illusion which the audience are unable to explain. When the curtain rises a mahogany box, to all appearances a coffin, is seen resting on four small wooden legs: behind it stands the magician. As he makes passes with his hands the motionless form of a beautiful young woman is seen to slowly rise from the coffin. Stretched at full length, and without any apparent support, she remains in the air while the performer passes a hoop the full length of the body, giving absolute evidence of no support below. After the hoop is removed in the reverse direction, the body slowly descends into the coffin and the curtain falls. The illustration explains how the trick is done. The body rests upon a steel framework (B) which is securely fastened to the iron which is fastened to an upright steel shaft at D. This shaft which is painted black does not show at a short distance, and is raised and lowered by a man below the stage.

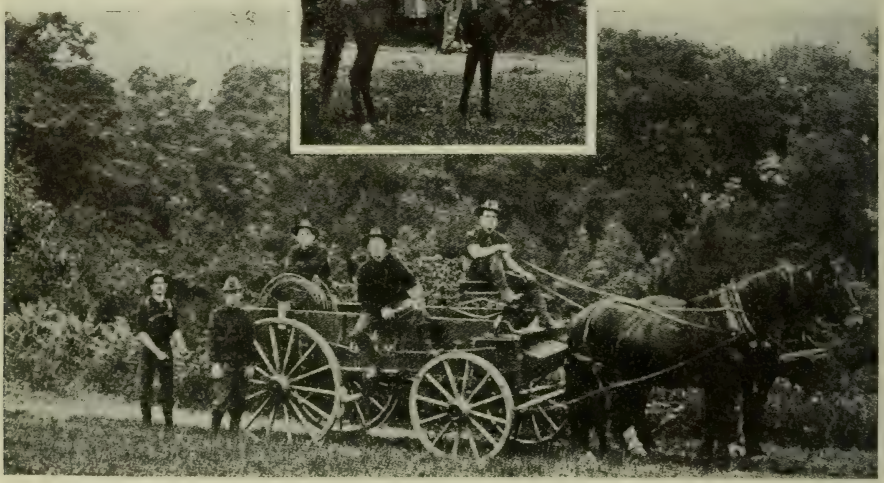
AMERICA MAY BE EXCLUDED FROM THE WHALING INDUSTRY.

Two tons of whalebone were purchased in London recently at $15,000 per ton, and besides this the world has but four tons visible supply left. Now American whalers may lose their share in this profitable industry, for the Canadian government is endeavoring to exclude all but Canadian whalers from Hudson Bay.

American whalers have always met with great success in these waters, where the finest grade of whalebone is obtained. In 1902 one Yankee ship secured 7,000 pounds of whalebone, which was valued at $25,000. If Canada succeeds in her purpose only Canadian, English and Scotch whalers will have access to the Bay.

Armies Have Telephone Scouts

Among the most important points of a modern well equipped army is the use of telephone scouts The scout's duties under any circumstances are attended with great hazards, and yet his services are indispensable. Of old, he was frequently sent out on long trips to spy out the lay of the land and obtain all the information he could about the opposing forces, only to return to camp to be sent back for some important detail which new conditions had brought up or his officer's oversight had failed to emphasize. Once again he was obliged to make the perilous trip, from which, brave as he was, he had been glad to return, and often several trips were made before the information was satisfactory.



U. S. Telephone Detail Party—Conductor Paid Out From the Wagon.

Nowadays, when a scout starts out to find out all that observant eyes and a mind trained to military affairs can about the foe, he is accompanied by a man carrying a telephone instrument and paying out a single line of conductor as he goes, or sometimes the scout carries the telephone himself, though more frequently he gives his undivided attention to the field glass, dictating his observations to the telephonist, who transmits them to headquarters, where, if any orders are to be given, they can be given at once, or any questions asked and answered at once, and all the work necessary is included in the one trip. The attendant usually carries the reel of conductor and the batteries on his back until the site for the observations is reached.

A Telephone Scout Dictating to His Telephonist.

A ground return is used, the connection being made by striking a hatchet or bayonet into the ground and wrapping one end of the wire around the exposed part of it.

Sometimes the distance is so great that a wagon carries the reel of conductor as far as it dare go and then the scouting party proceeds alone. If the line is to be left in place, sometimes it is laid in protected places or attached to trees and other supports.

All great military powers use the telephone in this manner. In the present war the Japanese use it thus. It is also used for communication between

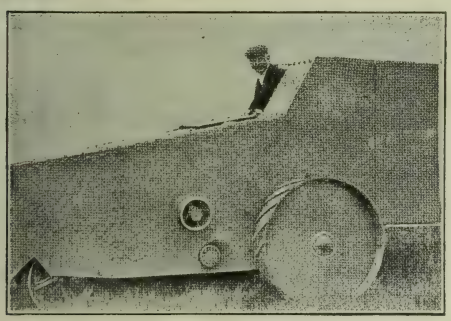
the often widely separated camps of an army. In each camp a special cordless switchboard and specially constructed telephone instruments are installed," says the American Telephone Journal, and are found to be of invaluable assistance in emergencies.

AN AUTOMOBILE HOSPITAL.

Built of Steel and Bullet-Proof, for Field Hospital Service.

To a young lieutenant in the British army credit is due for an invention which will be a boon to his wounded comrades in time of war and is another effective agency for ridding the battlefield of some of its horrors. During the Boer war the inventor was with the troops which met the most stubborn resistance and all around him fell comrades who, despite an efficient Red Cross corps, must lie there and suffer while the battle raged.

The invention conists of a bullet-proof motor for field ambulance work and is designed for the use of army medical officers and stretcher bearers on the field of battle. The mechanism of the machine is very



Bullet-Proof Hospital Automobile.

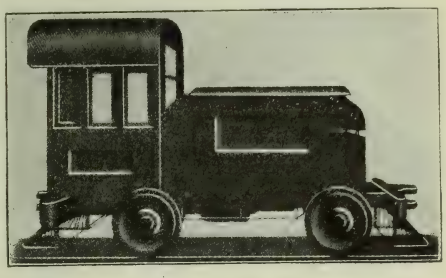
simple. The bullet-proof shields can be extended, wing fashion, to protect two sets of stretcher bearers in the firing-line. The motors are 3-wheeled and can be used for hospital traction or for driving ice-making machines for the field hospitals.

FORGING IRON SERIES REPRINTED

The series on "First Lessons at the Forge," which has been running as a serial in this magazine during the past few months, has been reprinted complete in pamphlet form and will be mailed to any address on receipt of 10 cents. Address Popular Mechanics.

GASOLINE LOCOMOTIVES BUILT FOR INTERURBAN SERVICE.

Gasoline engines and also gasoline motor cars are being built by a Kansas City company. The engine is of the vertical single



Gasoline Locomotive for Passenger Serivce.

cylinder four cycle type. A cam opens the exhaust valve and a vacuum formed by the descending piston opens the intake valve. It is water jacketed, a centrifugal pump driven from the main shaft circulating the water. The ignition is by means of an electric spark.

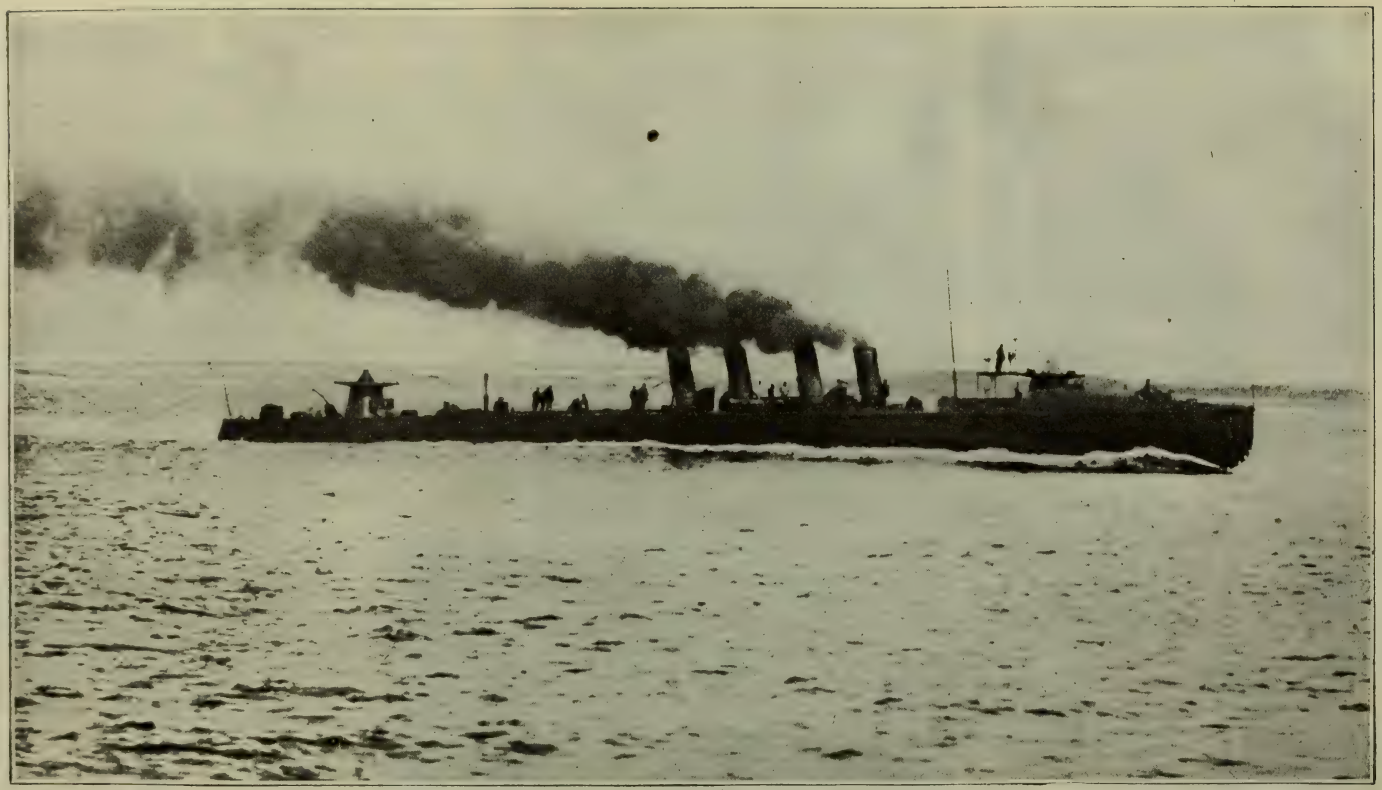
The engine runs continuously in one direction, and the power is transmitted to the wheels through a reversible clutch. This is so designed that the car is started and stopped smoothly and can be run in either direction while the engine runs continuously one way. The faces of the friction lock the driving gear by impingement. The clutch is on an intermediate shaft, which is geared to the driving shaft.

The weight is distributed to three points by making one support over the center of the axle and equalizing it across to the boxes.

The storage of gasoline is carried on the truck in a tank with walls over ½ inch thick. The gasoline is not fed by gravity, but is carried over by mechanical action only when the engine is moving. A lower grade of gasoline can be used, thus reducing the operating cost considerably.

In the gasoline motor passenger car one end of the body has a section of floor removed to accommodate the elevated part of the engine within. This is shut off from the passenger section by a partition.

Each of the locomotives has power enough to haul a passenger coach or interurban car at good speed It carries supplies for a 100-mile run and one man only in required to operate it.



Courtesy Journal American Naval Association

U. S. S. "Lawrence," Torpedo-Boat Destroyer, at a Speed of 31 2-5 Miles Per Hour.

In one of nine tests the "Lawrence" attained a speed of 33 3-4 miles, the speed required being about 30 miles. Her length over all is 246 feet 3 inches, beam 23 feet 3 inches, depth 19 feet 9 inches, displacement 400 tons. Her armament consists of two 3-inch semi-automatic rapid-fire guns, five 6-pounder semi-automatic rapid-fire guns, and two tubes for 18-inch Whitehead torpedoes.

Cleaning Streets with Compressed Air

No Brooms, No Dust and No Unsightly Machines

Machine at Work -- Left-Hand Valve and Nozzle Open

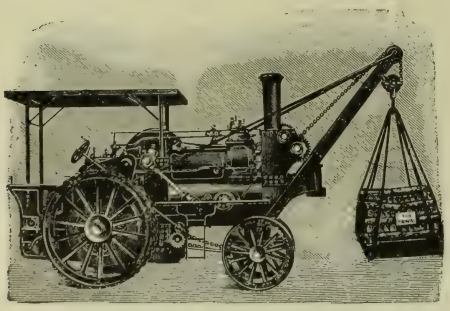
The street sweeping machine which for years has left clouds of dust in its wake, and hurled stones in all directions as it passed, will now have to go to the scrap heap, where it belongs. The new method is dustless, noiseless, and very much cheaper to operate. No sprinkling wagon is required to prepare the way: the new cleaner does its own sprinkling. Compressed air is the power and water is the

Center of Street Cleaned -- Washing Both Sides of a 32-Foot Roadway Clear to the Curb

medium with which the work is done. Two steel tanks are carried on each wagon; the larger for water, and a smaller tank contains the compressed air. When the driver moves a lever, the nozzles beneath the wagon are opened, and driven by the air, the water rushes out on either side, sweeping all dirt to the gutters. The force of the water is regulated by the driver, and cleans effectively for 30 to 40 feet on each side. The middle of the street is cleaned by another wagon which precedes. One supply of air is sufficient for several tanks of water, and when the air pressure is exhausted the tank is filled from a reservoir of compressed air carried on a supply wagon. There is practically nothing to wear out, the first cost is much less than the revolving-broom wagons, and the expense of compressing the air is comparatively small.

SELF PROPELLING CRANE.

A steam crane for heavy work around docks and in factory yards is being built in France. The new crane utilizes the usual features of the traction engine, with the addition of a derrick carried at the front end and operated by the machine's own power. The outfit can be run to whatever place it is needed and saves the work of many men.

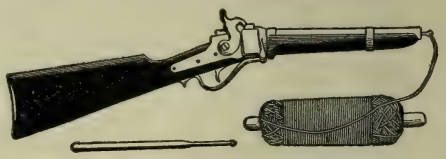


Traction Crane

The United States may have a national naval abbey in which the deeds of her naval heroes will be sacredly commemorated in a manner calculated to inspire the youth of the country with high resolves. The government has appropriated $10,000,000 for enlarging the naval academy at Annapolis and the chapel which is one of the new buildings may be used for this purpose.

NEW GUN THROWS A LINE LONG DISTANCE.

A new gun for throwing lines for life-saving purposes will throw a line from 200 to 400 feet, the distance varying with the force of the wind, with great accuracy and without the operator moving from his seat.



Lyle Line-Throwing Shoulder Gun

These Lyle line-throwing shoulder guns are equipped with a wooden box, 32 by 12 by 5 inches, containing four projectiles, standard size blank cartridges, cleaning rod, etc.

The guns are so small and compact that they can be easily used from almost any size craft, throwing the line to a vessel by which a hawser may then be sent aboard. They have many points which will make them rank high among life-saving devices.

CARRY MAIL IN MOTOR OMNIBUSES.

Motor omnibuses are now used in sparsely settled districts of England for carrying mail. The omnibus system was put in by a railway company to serve as a feeder to its line, and in time proved itself so adequate to meet the conditions and so much better than fixed lines of railway that the Postmaster-General decided to make use of it for the distribution of mail.

The 'bus system includes both passenger and luggage compartments. The passenger compartment seats 10 persons and the luggage van, in case of need, can be converted into an additional compartment for passengers. When used for luggage only, a ton of parcels and baggage of all kinds can be stowed away within it, and more can be placed on the roof. Passengers are taken up en route, and when the passenger compartment is overtaxed the luggage space is given up for their accommodation, parcels, boxes, etc., being left for the next van in preference to a passenger, though, of course, the mail bags are never left behind. The system has been so satisfactory that a number of new motor omnibuses have been ordered.

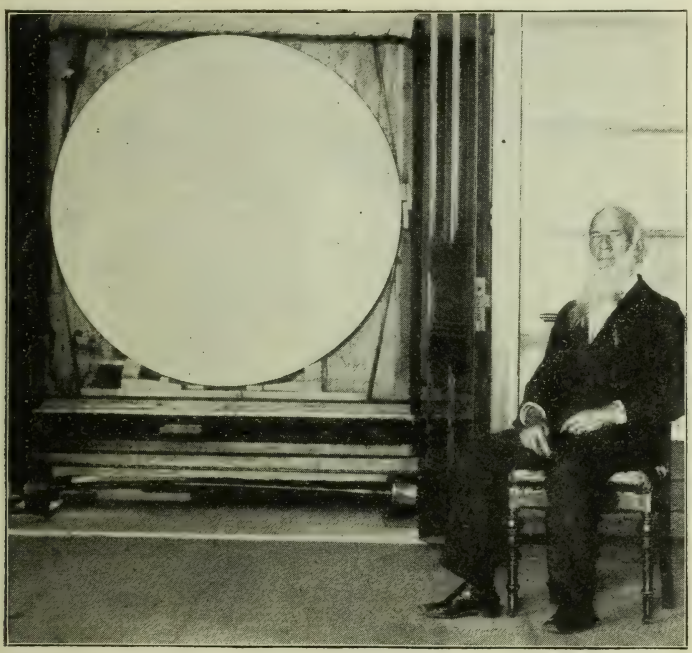
Show "Pop" to your friends.

Largest Lens In The World

Cost $100,000--Makes a Hair Visible 300 Feet Distant--Important Discoveries Expected From Its Use

At the American University, Washington, D. C., an observatory is soon to be built and the great reflecting lens of the late Rev. John Peate mounted and placed therein at a cost of $100,000. Great things are expected of this lens when mounted, it having been declared upon its completion in 1898 to be the largest in the world. Its diameter is 62 inches and it is 5⅜ inches in thickness.

The maker of this lens took up the study of the methods of polishing glass late in life. In all he made 16 fine lenses, some of which are now in use in distant lands. He was past 75 years of age when he made his greatest lens—the one for the American University. It was no easy task to find a glass manufactory that would undertake to cast a 62-inch lens. Five times the molten



A Great Lens and Its Maker

At present it stands in the corridor of the College of History at the American University.

After its completion, in the workshop of Rev. Mr. Peate, Greenville, Pa., it was tested before being sent to Washington. A dial the size of an ordinary watch was placed 100 yards distant from the big lens. A word was written upon its face with a lead pencil. A pin was placed in the center of the dial and a hair was used as a hand. Dr. Peate's lens magnified this dial 10,000 diameters, every part of the dial being prominent. Though unmounted, by its use, it is said, that Dr. Peate was enabled to detect stars which never before were visible.

glass had to be poured into the mold before a perfect result was obtained. Before being polished the casting weighed a ton. When completed its weight was 1,500 pounds. Three months were required for the operations of polishing. Rev. Peate in his work used an enormous grinder which he himself manufactured. In all, two years were required to make his famous lens.

Despite the fact that last year, in many European districts, beet sugar was sold at an absolute loss, Europe now has 3,861,861 acres sown to sugar beets and it is expected that this acreage will yield 5,520.000 tons of beet sugar. A great deal of old sugar is on the market.

LATEST WIRELESS TELEGRAPHY TOWER

The Tesla central power plant and transmission tower for the transmission of wireless world telegraphy is nearing completion.

Tesla Central Power Plant and Transmitting Tower

It is located at Wardenclyffe, Long Island, N. Y., is a pyramidal tower having eight sides, is 185 feet high and emits a transmission wave complex of a total maximum activity of 10,000,000 horsepower, so say its promoters, one per cent of which will circle the globe.

This is but the first of a number of towers which are to be scattered over the world, each near some great center of civilization for the transmission of World Telegraphy. Each such tower, it is said, can operate hundreds of millions of pocket-size instruments which can be set up anywhere on ocean, mountain, or desert plain and there will receive any messages intended for it and the news of the world. The entire population of the world will then be in direct communication. What would such an instrument have been to Livingstone when he took those long, dangerous journeys into the interior of Africa, or to Robinson Crusoe on the desert island! What a boon, when the system is in perfect working order, as it undoubtedly soon will be, to ice-imprisoned Alaskans or vessels at sea! What an important part it will play in military tactics! and who will have the best of the game? Too bad it was invented after everything else but the North Pole had been discovered.

TRAVELING POSTOFFICE IN ITALY.

The leading cities of Italy are now equipped with automobile postoffices which run on regular schedules. Stops are made at prominent places where the office opens for business, selling stamps, registering valuable letters, and selling money orders.

Italian Automobile Postoffice

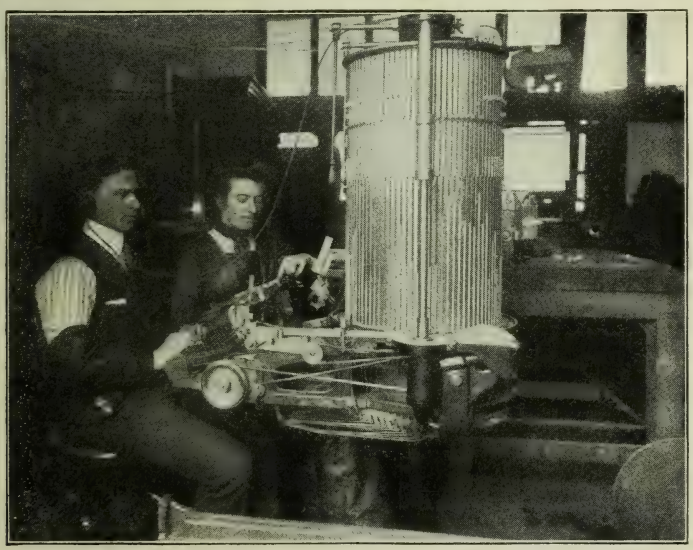
Letters can also be mailed, and runs to the main postoffice are made at frequent intervals.

ENGINE "999" NOW HAULS A MILK TRAIN.

The famous engine "999" which was the pride locomotive exhibit at the Columbian Exposition and broke the record for fast time when it drew the Empire State Express across the continent at a high rate of speed, now hauls a milk train at the rate of 17 miles, between Messena and Utica, New York.

NEWS PUT IN TYPE WHILE IT IS HAPPENING.

While on the football field cheers and cries of encouragement rang out now for one team, now for the other, miles away in the printing office of the Daily Press of Ashland, Wis., a linotype operator was setting up the story of each play as it was made as though he were an eye witness of the game and without a moment's delay. Even as the game was finished, bulletin boards announcing its outcome were posted and the story in detail was being rushed to the presses to come out in an incredibly short time.



Receiving Copy by Telephone

Telephony accomplished these results. A reporter had a well located booth at the ball grounds and told the story over the telephone to the operator of the type-setting machine, who had a telephone receiver fastened to his ears and who set up the words as fast as they were spoken to him. Of course, the circuit was private for the time being, so that no other paper could "scoop" the news. In this way the paper manages to get the latest news out in the shortest possible time. Much depends on the alert, observant eyes of the reporter and the quick ears and ready mind of the linotype operator. News so received cannot fail to be accurate and shows the marvelous power of the human brain to receive ofttimes the most startling intelligence and at the same time control the hands.

PRESERVING TREES HAVING HOLLOW TRUNKS.

If a valuable shade or orchard tree is injured so as to cause a cavity, remove all decaying material from the cavity, using a chisel, until sound wood is exposed. Then mix a thin mortar of one part Portland cement to three parts clean sharp sand and fill the cavity with it. Let it become stiff, but not hard, and then coat the surface with a mixture of one part sand and one part cement so that all the moisture will be excluded from the cavity.

It is well to treat the inside of the cavity with a solution of one pound of copper-sulphate to five gallons of water after the decayed material has been removed and just before pouring in the cement.

SCRAP LEAD ROOFS.

The use of lead for roofs is coming more and more into favor and it is capable of the most beautiful architectural effects. It is most suitable for low flattish roofs, and is adapted to highly decorative designs. Scrap lead, because it contains a small amount of tin, or antimony, and does not readily corrode, is much better for the purpose than pure lead, which soon becomes covered with a white coating.

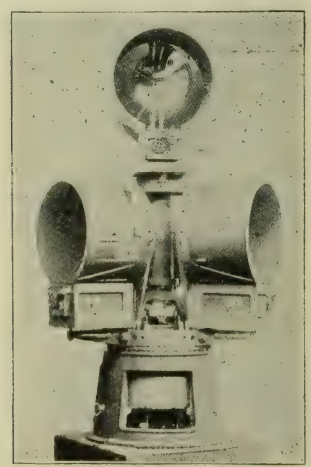
Send $3 and receive Popular Mechanics for 60 months.

Electric Lights for Lighthouses

Electricity is superseding the oil lamp for lighthouse purposes just as it is supplanting gas and oil and steam for many other purposes. Many of the modern and prominent lighthouses on the coast are now equipped with the electric light.

Among the most modern and finest of these is the new lighthouse at Heligoland at the entrance of the Elbe river, Germany. Two hundred and seventy feet above high water mark it stands and flashes its powerful light far out over the waters. It emits a total light of over 30,000,000 candlepower and mariners recognize it by its flashes of one-tenth second duration, emitted every five seconds. At a height of 12 feet it is visible 25 miles from the lighthouse.

Two hundred and twenty yards from the lighthouse is a small station equipped with two steam dynamos, one for reserve, the other for regular use. From this place the current for the lights is supplied. In a room directly below the lantern is located the switching apparatus. Each of the three lamps are supplied with a direct current of 34 amperes. Three reflectors, 30 inches in diameter, and placed at an angle of 120 degrees, are mounted on a platform, which completes a revolution every 15 seconds; this arrangement regulates the 1/10-second flash.



Three Complete Lamps for the Lighthouse

The platform is supported on a ring of steel balls of large diameter, this does away with the vertical axis formerly used for holding the platform in a horizontal position, and the space the axis would otherwise occupy is used for electrical connections. Six mercury contacts convey the current to the lamps and to the motor which rotates the platform. These contacts are ring-shaped iron basins filled with mercury and insulated from each other by pieces of mica. On the rotating platform are switches which dip into the basins of mercury and are connected to terminals which lead to the machinery.

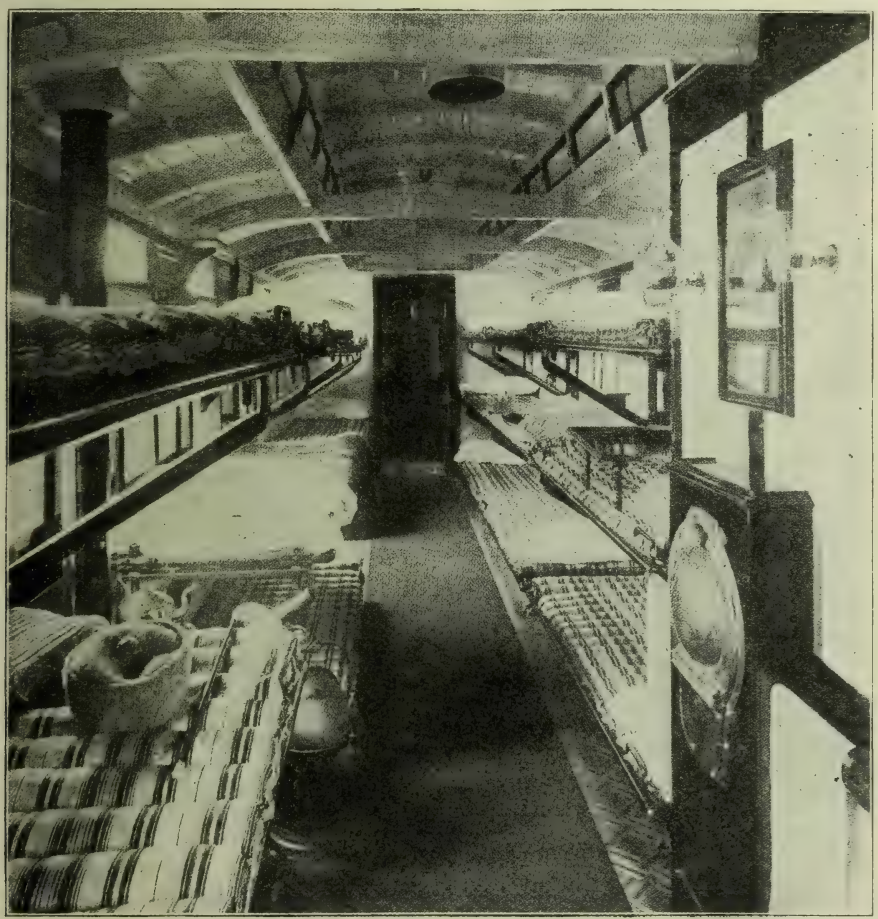
Heligoland Lighthouse at Night

The reflectors are paraboloidal and have a focal length of about 10 inches; within this focal length the arc must always be kept and to insure this, small lenses and mirrors are placed so they will throw the image of the arc on the pieces of opal glass which are mounted on the reflector case. The position of the arc is adjusted by vertical and horizontal marks on these pieces of opal glass, the horizontal line passing through the center of both carbons and the vertical line through the tip of the positive crater. Lighthouse reflectors are now made of glass, coated with silver.

An English automobilist made a run of 2,068 miles in 106 hours running time, part of the trip being over the Grampian Hills. "My father," was not feeding any flocks at the time, as the run over the Hills was made about midnight, including as diversion going off a bridge into four feet of water.

Finest Hospital Train Ever Built

The handsomest hospital train in the world was built during the Boer war by the English contributions, chiefly from the town of Windsor, the Central British Red Cross Committee and the Princess Christian, after whom the train was named because of her great interest in the venture. This magnificent train, which consists of seven vestibule cars, each 36 feet long and 8 feet wide, with continuous passages through them, and perfectly equipped in all its various departments to give the quickest and most efficient help to sick and wounded soldiers, was built in the short time of 10 weeks, says the American Inventor.



Hospital Train Beds for Wounded Soldiers

Car No. 1 is divided into three compartments, one for linen and stores, another for two invalid officers and the third for two nurses. Car No. 2 has one compartment for two medical officers, another for a dining-room for the staff and one other for a dispensary. Cars Nos. 3, 4, 5 and 6 are arranged with three tiers of iron brackets on each side with wire netting to support hair mattresses and will each accommodate 18 patients. Pulleys are arranged in the roofs of the cars for lifting the beds with the patients on them to the height where they can be easily placed on the iron brackets. Car No. 7 contains the conductors' quarters, a kitchen and berth for the cooks, and each of the cars has a closet, a lavatory, lockers for stores and a tank for water.

The train carries at its head two flags, the

Union Jack and the Red Cross. On its center panel at each side is painted a large Red Cross on a white ground, encircled by the name of the car, "Princess Christian Hospital Train," in royal blue and gold. The train is provisioned and equipped and is commodious enough to maintain 97 persons two or three weeks. In its first five weeks of service 70 invalid officers, seven sick nursing sisters and 875 non-commissioned officers were brought from hospitals along the railway lines into Durban without an accident of any kind.

A hospital train built along the same lines is now going into service on the Trans-Siberian railway.

A CHAIR MADE IN ONE PIECE.

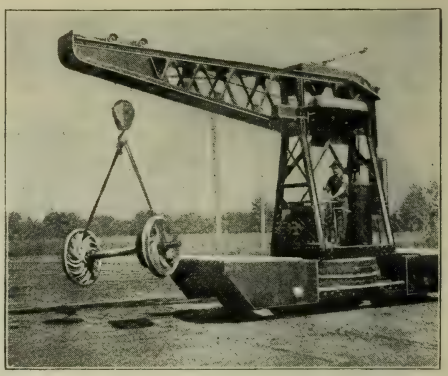
A native of South Africa, who had never made use of chairs, but had seen settlers use them, succeeded in making one of the most unique chairs in the world, says The Furniture Journal. To his untutored mind

A Chair Without a Joint

the idea that chairs were made of parts joined together never occurred, and wishing to possess one, he laboriously cut it out of a solid block of wood. When finished, there was the right form, the same serviceable article, but without a joint of any kind.

A PORTABLE PNEUMATIC JIB CRANE.

A large traction company of Cleveland, Ohio, has in use a portable pneumatic jib crane for handling trucks, wheels and oth-



A Portable Pneumatic Jib Crane

er general hoisting. The crane is mounted on a single truck with a lengthened wheel base and is propelled by two electric motors, mounted outside the axles so that the crane can be used both in the shops and on the road. It is furnished with a self-contained air compressor and thus all the hoisting, revolving and racking is done pneumatically. The crane has a lifting capacity of five tons

TYPEWRITTEN MUSIC.

The latest thing in typewriters is a machine which will eliminate all the tedious labor of preparing music for publication and will eventually reduce the cost of copies of music of limited circulation.

The new machine is much like other typewriters, except that it forms the scale as the operator proceeds, besides registering the characters. It not only registers the notes, bars and rests, but also marks the lines at the same time. A single machine sells for $300 at present and a company with $200,000 capital has been formed. Probably the next improvement will be a means of attaching the typewriter to the piano so that, as the great musician improvises, the music will be typewritten simultaneously, and without intruding on the inspired moment.

Popular Mechanics five years for three dollars.

French Auto Street Sprinkler.

AUTOMOBILE STREET SPRINKLER.

Auto watering carts are now being used in Paris. The carts are driven by 35-horse-power steam engines, have a capacity of 264 gallons and can be filled in six minutes. The water is sprayed by means of a pump driven by the rear wheels which arrangement regulates the delivery exactly in proportion to the speed of the vehicle. The spraying nozzles are adjustable, according to the weather, by the hand wheels projecting back of them. The two nozzles spray to the width of 25 feet. The cart has a maximum speed of nine miles, but the average is five miles.

HOW TO PRINT PHOTOGRAPHS ON GLASS OR CHINA.

Rose bowls, placques, fruit plates and numberless other glass or china articles can be prettily decorated with pictures by the amateur who is willing to exercise a little care. Familiar scenes and faces are the most suited to this work and the article thus decorated makes a pretty gift for a friend.

For flat surfaces plates will do very well for this work, says a correspondent of the American Amateur Photographer, but for rounded surfaces film negatives must be used. The object to be decorated and the tint of the print should harmonize.

Coat the article with a gelatine solution applied with a flat brush. Make a sensitizing agent of 6 drams red prussiate of potash and 4 ounces of water, shaking them well together, and placing in a dark room until thoroughly dissolved. In a separate bottle mix 7½ drams citrate of iron and ammonia and 5 ounces of water. When both solutions are thoroughly dissolved take equal parts of each, place in a bottle and shake together. With this solution coat that part of the gelatined surface where the picture is to be printed and leave in a dark room until thoroughly dry.

When it is dry fasten the negative in place by means of adhesive tape, rubber bands or anything which will hold it firmly in contact with the surface, and print in strong sunlight for half an hour, not disturbing the film in the meantime. At the end of the half-hour remove the film and wash the glass 15 minutes in clear water. This process will give a beautiful blue print, and the article bearing it may even be washed carefully in cool water.

Brownish or dark tints may be had by substituting the following sensitizer: 50 grains silver nitrate dissolved in 1 ounce of water.

FUEL OIL FOR NAVAL USE.

The use of fuel oil for marine purposes has been declared practicable by the liquid fuel board of the navy, which has been conducting tests in this line for the past 28 months. The board reports that no trouble in burning oil in a uniform manner will be experienced by an intelligent foreroom force, but that a liquid fuel system, which will not permit of a return to the use of coal within 24 hours, should be installed on no ship.

Wireless Telegraphy On Board Ship

By Guglielmo Marconi

The first daily newspaper published by means of wireless telegraphy in mid-Atlantic waters, the news of the hour being winged over thousands of miles of ocean expanse, was in all respects a success such as would satisfy the hopes and desires of the most sanguine inventor.

On board the Cunard liner "Campania," voyaging from Liverpool to New York, messages were sent to and received from both sides of the Atlantic, and at all times the vessel, which, ordinarily, would have sailed into port unknowing what news of good or ill awaited her, was in touch with all the events of general interest which were transpiring. Had she caught fire, collided with another vessel, or foundered in mid-ocean, news of her peril could easily have been sped to either continent, but no help could have been sent her, for no other vessel on the waters, unless it had instruments keyed exactly as the ones we were using, could have taken a message, and to key them like ours would have been almost impossible.

The voyage was taken for the purpose of testing a combination of the best points of four keys, the new instrument used having the greatest range of anything of its kind ever made. My stateroom was on the port side of the vessel and in it I installed my key, with the wires running to the truck of the foremast. On leaving Liverpool the vessel was put in communication with the shore stations at Poldhu, Crookhaven and Seaforth Sands. The distance traveled was 3,636 miles. We kept in communication with Poldhu for 1,700 miles, which is more than half seas over, and then we started on Cape Breton, and kept talking to that place during the rest of the voyage. So we were in communication all the way over. Everything sent to the land stations was received, and the only mistake made was in the name of Gen. Sir H. C. Wilkinson, a passenger on the "Campania," whose name at a distance of 1,000 miles was received "Wilson."

Nothing speaks more for the success of the test than the fact that contracts have been entered into to install instruments, both for sending and receiving messages, on all the vessels of the Cunard line.

My next experiment will be that of girdling the globe by means of instruments on vessels at sea. The British government has placed several of its warships at my disposal, and the next three months will be devoted to fitting them with the long-distance keys and receivers. Then they will be stationed at different points around the world, and I shall try to pick each one up in succession.

ELEPHANT AIDS LINEMEN.

While installing a new telegraph span in Assam, India, H. Hervey, former government telegraph inspector of India, was furnished with two enormous elephants to help carry on the work in the dense jungles where these were the only beasts of any practical value. There were many spanned rivers in the territory, great bundles of bamboo from 60 to 80 feet high being used, which were most awkward and wobbly and could only be held in position by means of many guys.

When the force were putting the last touches on a new span one night, the line broke and fell into the water, where it sank into the sandy bed, so that when the end had been recovered, hoisted on to the mast, hand-dragged as near to the check post as possible and the straining tackle applied, the rope could not be moved. Every person near lent his aid at hauling, but to no avail. Then the elephant man who had charge of the huge tusker, Tomboy, suggested putting the elephant at the task. The animal understood the instructions given him, seized the wire with his trunk and backed away, drawing the line out of the water. As soon as the wire left the water, the signals given over it from a distant station gave the elephant a series of electric shocks, so that he winced, but did not let go his hold until the wire was safely on the tackle.

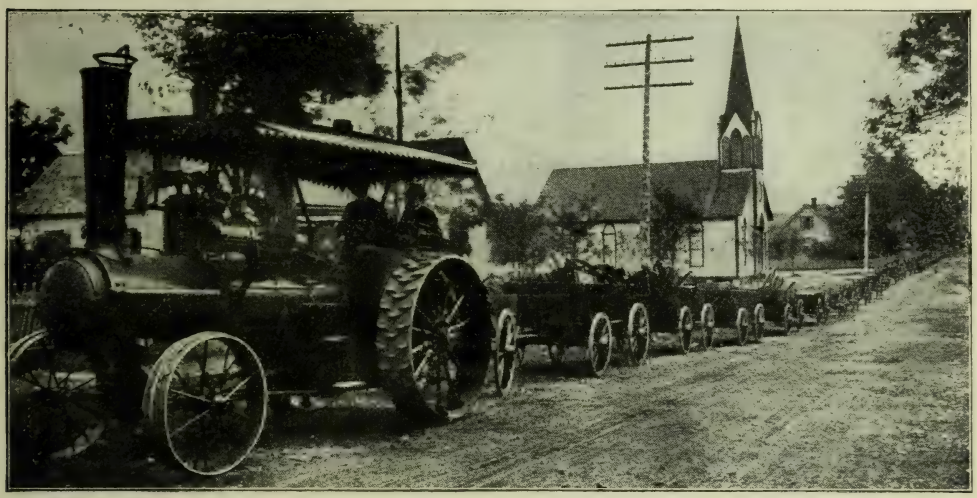
INK FOR WRITING ON GLASS.

A good ink for writing on glass is given by the Photo-Beacon. Dissolve 60 grains of shellac in 1 ounce of alcohol and, separately, 90 grains of borax in 1½ ounces of water. Mix the two solutions gradually, almost drop by drop, and if a deposit forms, heat at once. Then add enough aniline dye of any color desired to give it density. The amount of water used is an important factor and should be just enough to make the ink flow easily from the pen.

TRACTION ENGINE DRAWS A LONG TRAIN OF WAGONS.

A shipment of 30 wagons, weighing 26,950 pounds to be delivered from a railway station to a warehouse six miles distant:—How much labor is involved, how many horses will be required, and how many hours will it take to do the work?

Two men can do it two hours. At least that is what Roy & Jones of Alexandria, Tenn., did. The wagons were set up and coupled together and then, over the peaceful country roads which had never before known a like event, the train, nearly a quarter of a mile long, was drawn by a



Delivering a Train of Wagons from the Station to the Warehouse.

14-horsepower traction engine. Only once in the entire trip was it necessary to uncouple any of the wagons, a bend in the road causing the stop. The road was macadamized and in fine condition.

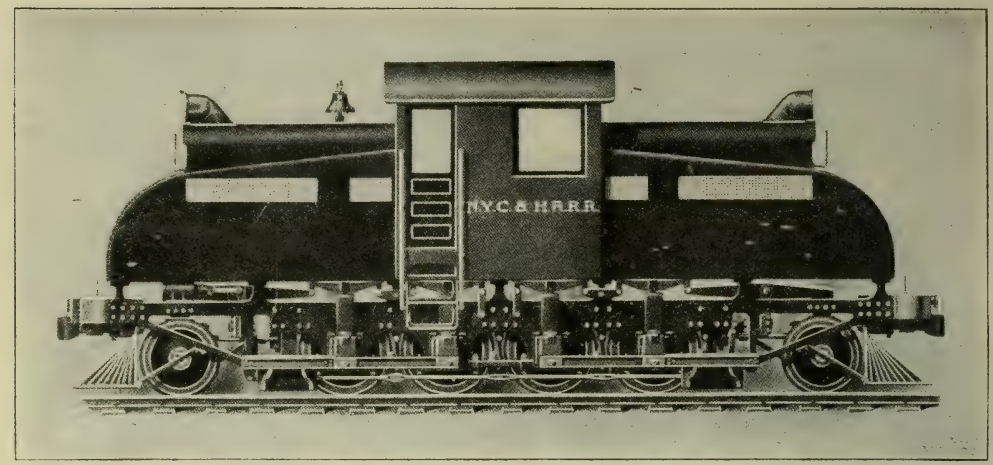
NOTED AUTHORITY DECLARES AGAINST THE TURBINE.

Rear Admiral George W. Melville, U. S. N., says the steam turbine is 20 years ahead of its time. That while it may be efficient for high speed machinery it is too leaky for propulsion, where the speed of the revolution may vary from 90 to 120 turns per minute. Engineers of prominence everywhere are unanimous in declaring that the Admiral has made a mistake. Fresh from an extended tour of observation in other countries, he still holds to the old form of reciprocating engine as best for ship purposes. As head of the Naval Bureau the Admiral has for many years promoted the use of this type of engine. The American Shipbuilder says:

"The Admiral's attitude toward the turbine is distinctly unfortunate for his reputation and is somewhat similar to that which opened the eyes of engineers to the limitations of Edison, who, when at the height of his popularity years ago, stated that a dynamo's greatest economy could not exceed fifty per cent. Edison's assertion was so quickly and widely challenged that his company was forced to discard his ideas, and to call in outside talent to revise the output, in order to save the entire business from going to wreck through the sudden revulsion of sentiment on the discovery of his ignorance of the principles of design." And again:

"Does any sane person believe that the most conservative steamship company in Great Britain would 'gamble' away six million dollars upon an experiment in building steamships with turbine engines? Not much! The Cunard people are no fools; they know exactly what they are doing, and the engineering world will run riot in its eagerness to equip new steamships with turbine engines after the Cunard company's first mammoth turbine ship makes her maiden trip to New York."

Electric Locomotives for a New York Line



Electric Locomotive for the New York Central & Hudson River R. R.

All the great electrical manufacturing companies both in America and abroad sent in bids for the construction of the electric locomotives which are now being built for the New York Central and Hudson River Railroad and the result is that the new locomotives promise to be remarkable features in this line of electrical construction and to surpass any engine yet placed on rails and will interest all great railroad companies.

The company required that the successful bidder (the General Electric Company and the American Locomotive Company) should produce a locomotive capable of making two regular successive trips of one hour each between Grand Central Station and Croton, a distance of 34 miles, with a total train weight of 550 tons, a single stop in each direction and a lay-over not to exceed 20 minutes. In addition to this it was provided that a similar schedule should be maintained with somewhat lighter trains making more frequent stops. Finally, it was provided that with a total train weight of 435 tons, the electric locomotive should be able to run from Grand Central Station to Croton without stop in 44 minutes, and, with one hour lay-over, be able to keep up this service continuously. This last schedule is the equivalent of the present timing of the Empire State Express, though the latter has a somewhat lighter train.

The contractors chose the direct current type of locomotive because it had shown itself reliable, but made a radical departure from all precedent in the use of bipolar gearless motors, the magnetic circuit, the field windings and the motor poles being integral with the locomotive frame and supported by springs. Four of these 600-volt direct current gearless motors of 550 horsepower each are to be used for the driving power, giving the locomotive a maximum rating of 2,800 horsepower, 50 per cent greater than the largest steam passenger locomotives of the present time.

One of these locomotives will measure 37 feet in length with a total wheel base 27 feet in length. The diameter of the driving wheels will be 44 inches and of the truck wheels, 36 inches. The driving axles will be 8½ inches in diameter. The locomotive will be a double ender and will weigh about 190,000 pounds. The journal boxes and axles will be so designed as to permit the engine to make curves of 230 degrees radius.

About 17,000 pounds weight will rest upon each of the driving wheels. The usual accessories of a steam locomotive, such as a bell, whistle, etc., and also an electric headlight at each end, will be provided. It is expected that with a light train these locomotives will give a speed of 75 miles per hour.

MECHANICS FOR YOUNG AMERICA

How To Build An Imitation Street Car Line

An imitation street car line may sound like a big undertaking, but, in fact, it is one of the easiest things a boy can construct, does not take much time and the expense is not great. A boy who lives on a farm can find many fine places to run

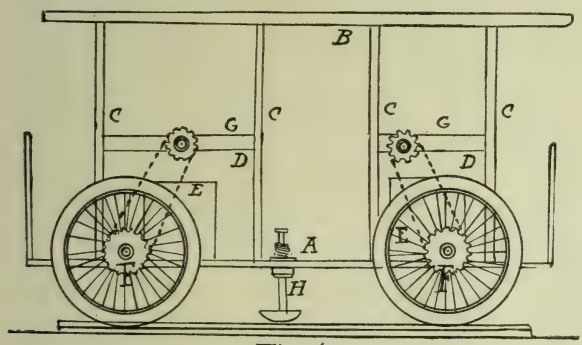


Fig. 1

such a line, and one in town can have a line between the house and the barn, if they are some distance apart.

Often all the boards and blocks required can be had for helping a carpenter clear away the rubbish around a new building. Wheels and parts of old bicycles, which can be used in so many ways, can be found at a junk shop at very low prices, wheels in good repair costing about 25 cents each. For the car for the street car line try to find a set of wheels having axles, but if you cannot find such, make shafts of hard wood, about 3 inches by 2½ inches and by

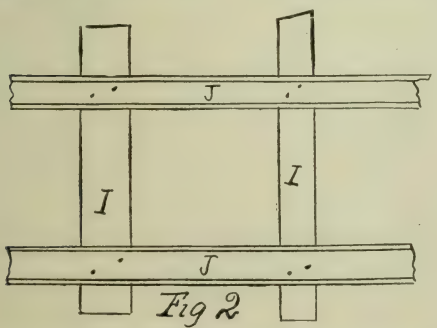


Fig 2

means of a jackknife turn, or shave down the ends to receive the hub bearings of the wheels. Fasten the wheel hubs securely over the ends of the wood with pins or little bolts, or if the wheel bearing is of such a nature that it revolves on its own journal, the journal can be fastened to the end of the wood piece. Each of the wheels should be provided with a sprocket; any chain sprocket of a bicycle may be used. Fasten these sprockets on the outside of the wheels as at F, F, Fig. 1. They can be set on over the bearing end and secured with a set screw, or the original key can be employed. It is best in cases like this to use the original parts. Make the floor of the car of pieces of boards placed on the axles and nailed, screwed or bolted, as shown at A. To erect the frame, place uprights C, C, C, C in position as shown, fastening the ends to the baseboards, and making the roof line as at B, then put in the cross pieces G, G. Seats E, E, are simply boxes. The drive of the car is effected by using the driving sprockets D, D, fitted to the crosspieces G, G, with the original bearings. The parts are thereby secured to the car and the chain placed on.

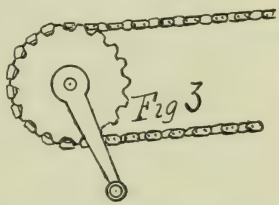


Fig 3

Key the cranks for turning to the upper sprocket's shaft and all is ready. If there are sprocket gears and cranks on either side, four boys may propel the car at one time. Considerable speed can be made on smooth roads, but it is the best amusement to run a car line on wooden tracks with a brake consisting of a piece of wooden shaft, passing through a bore in the car floor, and fitted with a leather covered pad as at H. A spiral spring holds up the brake until pressure is appled by foot power, when the brake contacts with the wooden track and checks the car.

The track plan is illustrated in Fig. 2. Get some boards and place them end for end on other pieces set as ties. The main

boards or tracks J, J can be about 6 inches wide, to the edges of which nail strips about ¾ of an inch wide and about the same height. The ties I, I can be almost any box boards. Wire nails are the best to use in putting the tracks together. The sprocket connection with the chain is shown in Fig. 3. This consists of the sprocket gear on the propelling shaft, and the crank. The pedals may be removed and a chisel handle, or any tool handle, substituted, so as to afford means for turning the crank by hand power. Great fun can be had with the road, and, furthermore, it can be made renumerative, as boys and girls can be given rides for a penny each.

How To Make a Water Bicycle

Water bicycles afford fine sport, and, like many another device boys make, can be made of material often cast off by other people as rubbish. The principal material necessary for the construction of a water

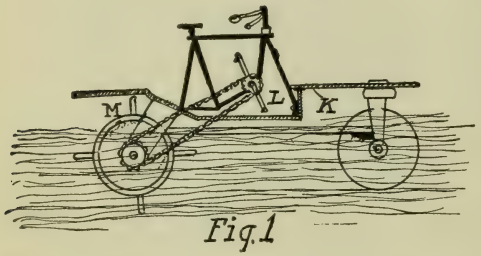


Fig. 1

bicycle is oil barrels. Flour barrels will not do—they are not strong enough, nor can they be made perfectly airtight. The grocer can furnish you with oil barrels at a very small cost, probably let you have them for making a few deliveries for him. Three barrels are required for the water bicycle, although it can be made with but two. Figure 1 shows the method of arranging the barrels; after the manner of bicycle wheels.

Procure an old bicycle frame and make for it a board platform about 3 feet wide at the rear end and tapering to about 2 feet at the front, using cleats to hold the board frame, as shown at the shaded portion K. The construction of the barrel part is shown in Fig. 2. Bore holes in the center of the heads of the two rear barrels and also in the heads of the first barrel and put a shaft of wood through the rear barrels and one through the front barrel, adjusting the side pieces to the shafts, as indicated.

Next place the platform of the bicycle frame and connections thereon. Going back to Fig. 1 we see that the driving chain passes from the sprocket driver L of the bicycle frame to the place downward between the slits in the platform to the driven sprocket on the shaft between the two barrels. Thus a center drive is made. The rear barrels are fitted with paddles as at M, consisting of four pieces of board nailed and cleated about the circumference of the barrels, as shown in Fig. 1.

The new craft is now ready for a first voyage. To propel it, seat yourself on the bicycle seat, feet on the pedals, just as you would were you on a bicycle out in the street. The steering is effected by simply bending the body to the right or left, which causes the craft to dip to the inclined side and the affair turns in the dipped direction. The speed is slow at first, but increases as the force is generated and as one becomes familiar with the working of the affair. There is no danger, as the airtight barrels cannot possibly sink.

Another mode of putting together the set of barrels, using one large one in the rear

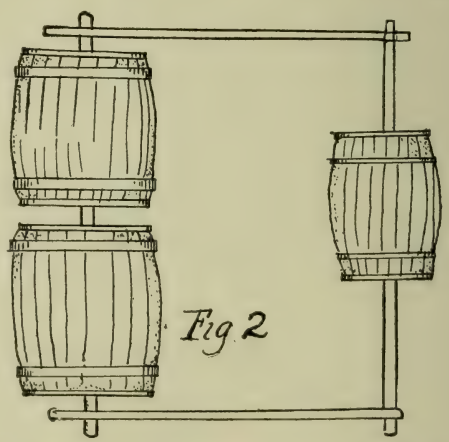
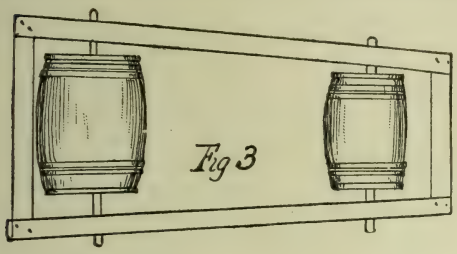


Fig. 2

and a small one in the front is presented in Fig. 3. These two barrels are empty oil barrels like the others. The head holes are bored and the proper wooden shafts are inserted and the entrance to the bores closed tight by calking with hemp and putty or clay. The ends of the shafts turn in the wooden frame where the required bores are made to receive the same. If the

journals thus made are well oiled, there will not be much friction. Such a frame can be fitted with a platform and a raft to suit one's individual fancy built upon it, which can be paddled about with ease and



safety on any pond. A sail can be rigged up by using a mast and some sheeting; or even a little houseboat, which will give any amount of pleasure, can be built.

SUBMARINE BOAT WINS IN ENDURANCE TEST.

The submarine boat "Fulton," which has been undergoing some severe endurance tests, has demonstrated fully the wonderful ability of these crafts to weather the rough seas during a gale.

On the night of June 6 this boat remained submerged to a depth of from four to ten feet throughout the night. Once during the night the foul air within the ship was pumped out and fresh air pumped in. The test was entirely without incident. On June 10 the torpedo boat made an endurance run of 60 miles from Newport, R. I., to New Suffolk, L. I., in eight and one-half hours. This was a half-hour longer than the scheduled time, but was caused by the heavy sea lashed into a fury by recent gales. Its ballast tanks were pumped out and it had just a few feet freeboard for the trip and it showed itself to be remarkably buoyant and able to hold its own on the storm-swept waters, although the men had to be lashed to the deck and much of the time the great rollers hid it from the view of those watching from the shore. How important these experiments are is readily comprehended in the light of the fact that each of these tiny boats carries a weapon against which the strongest warship of the world's navies is not proof, and in time the Navy Department may expend more money in constructing these than in building battleships.

A fuel test was also made on the trip, the boat being driven by a gasoline engine.

WHY THE AMERICAN BOY DOES NOT GO TO SEA.

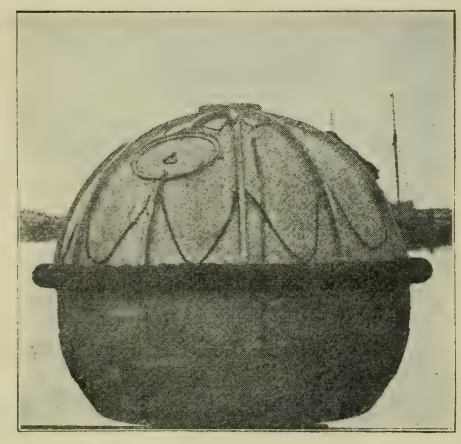
Why has the American boy stopped going to sea? This is a question that has been answered in various ways, but Frithiof H. Buryeson, a seaman of the old school, gives a new version of it in the Coast Seaman's Journal, that is possibly worthy of consideration. Because he can't stand social ostracism, he gives as the main reason—a condition that is brought about by the change of the times. And then Capt. Buryeson hints strongly that these changes have caused the American boy to become timorous and our marine suffers as a result. The American ship, he says, in all material respects has undergone no changes worth speaking of during a century past. The old time captain says:

"There is Dr. Lingeron, who lives on health foods and dispepsia tablets, and who thinks American boys don't take kindly to Old Briny because they can't digest the salt junk and the maggots in hardtack. Prof. Coffin, who wears a chest protector, and is the inventor of a brand new theory on the nature of colds in the head, is quite sure that a ship is altogether too draughty a structure to be a healthy abode for a young growing lad. The president of a 'Woman's Congress' declared, when informed of the fact, that it was simply outrageous that sailors should have their pie served cold to them during the night watches.

"The day has gone by forever when the sons of 'quality folks' run away from home to go to sea. The dreams and aspirations of the young millionaire hopeful of today usually run more to automobiles and to chorus girls than to ships. Prior to the Civil War the personnel of our merchant marine was mostly recruited from the backwood hamlets of New England. The New England boy of that day was a sturdy shoot of a sturdy civilization. His bringing up if applied to the pampered molly-coddles of this age, would land them in a graveyard inside of a year. His food was simple and wholesome, as were his pastimes. Stimulants, cigarettes and poisonous dime novels were unknown to him. He worked hard, but his work was all done in the open air, summer or winter, and it toughened him into a healthy animal, blessed with a good digestion and the ability to sleep on a clothes line with his head on a bucket of water if he had to."

LIFE-SAVING GLOBE MAY SUPPLANT LIFEBOATS FOR SHIP USE.

A life-saving globe, considered by eminent authorities to be the most perfect life-saving craft, with the exception of sailing and managing, for ship use yet constructed, has recently been invented by a Captain Donvig, of Copenhagen, who lost his entire family in a terrible wreck.



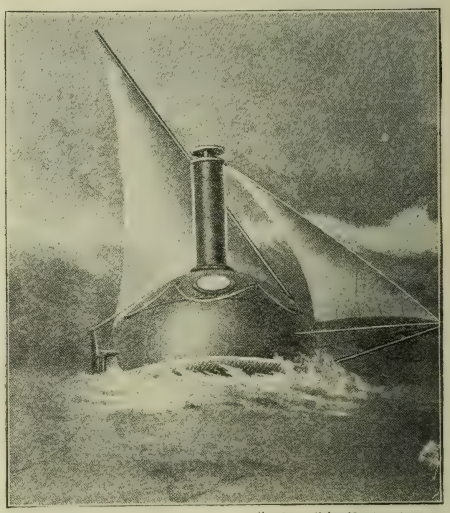
The Globe Closed

These wonderful globes will accommodate 16 persons and are so buoyant that in recent experiments when one was cast from a wharf 12 feet high into the water, it sank a distance and then immediately rose to the surface where it floated safely.

The globe is constructed of 3-16-inch steel plates, says American Consul Frazier, of Copenhagen, Denmark. They are in the form of a globe with a segment cut off, which leaves a flat part for the bottom. The bottom is double and within it can be stored 148 gallons of fresh water. Around the largest part of the globe is a fender of 16-inch coil rope. It is provided with an anchor having 600 feet of rope. The floor is a wooden grating and the sides are padded and provided with straps, with which 16 persons can lash themselves to prevent being tossed about. It also has a bilge pump; closet bucket; steel rudder and tiller, sails and oars. Lockers, in which can be stored 14 cubic feet of provisions, serve as seats for the crew, and for ventilation a 12-inch pipe can be raised through the top of the globe to a height of 5 feet, or lowered flush with the top of the globe. This pipe has a cover and padding for quick opening and closing when at sea. Glass lights in the sides furnish means for observation and man-holes in the upper part of the globe can be opened and closed from within.

The interior dimensions of the globe which was used for experiment is: diameter, 8 feet; height, 6 feet; space, 265 cubic feet; deck area, 54 square feet. Fully equipped it weighs 3,663 pounds.

The second of the tests to which the globe was put was made under conditions in which a lifeboat would have been helpless. The tests were made on the rugged coast of North Jutland when a heavy sea was on and the breakers threatened death. Captain Donvig accompanied by a Norwegian lieutenant of marines and three sailors was put off a ship in one of the globes. After rising to the surface the sails were hoisted and the strange craft steered across the perilous water to the shore. Fifty



Courtesy Scientific American

A Safe Voyage Over Stormy Seas

yards out the men left the globe and waded to the mainland. The trip was made in half an hour and was a success in every respect.

STANDARD SILVER DOLLARS FOR PANAMA.

A silver dollar of weight and fineness equal to that of the United States' dollar is to be used in Panama and the government there will recoin all current Colombian silver (about $1,500,000) into the coin adopted. Additional silver up to the amount of $6,000,000 is to be coined, 15 per cent of which will be banked to retain a parity with gold.

SHOP NOTES

WHAT TO DO IN CASE OF ELECTRICITY ACCIDENTS.

The first thing to do is to have the current shut off, or release the injured person from contact with the conductor of the current, if this is still acting upon him.

The person who attempts this must not touch with his bare hands or skin, or with any part of his body, either the patient or a live wire or a lamp or generator, while any part of his body is in contact with the ground, either directly or by means of a moist or metal surface. He should, if possible, put on rubber boots and shoes and rubber gloves. If these are not at hand he may use a dry board for the feet, and for the hands a number of coats or folds of woolen cloth or paper. A thick bundle of silk is also a good insulator. In cutting a wire, the feet should be protected as just indicated, and if an axe or hatchet be used it should be one with a dry wooden handle. After a live wire is cut, the end should be wrapped or insulated with a piece of cloth or rubber.

The person who has received the shock should be laid down, his clothing loosened and he should be given fresh air and the body should be kept warm.

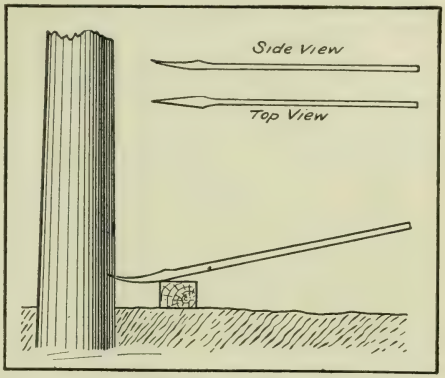
Rescuing from Contact with Live Wires.

If breathing is suspended, artificial respiration or rhythmical traction of the tongue, similar to the methods followed in cases of drowning, should be used. If the heart has stopped beating, several hard taps or blows with the hand may be given which may cause it to start up again. Burns of the surface caused by electricity may be treated in a similar manner to burns from fire.

These suggestions if acted on promptly will often prevent fatal results, but the Fabric Fire Hose Company says a surgeon should be summoned promptly in all cases.

HANDY TOOL FOR PULLING POLES

An ordinary crowbar with the end drawn out and tempered as shown makes a good tool for pulling poles, says the American Telephone Journal. The point of the tool is thrust into the pole near the base and a



Tool for Pulling Poles.

block or other elevation serves as the fulcrum. With three of these tools poles 70 feet long may be pulled and moved ahead 15 feet.

HOW TO TRANSFER PICTURES

Transfers instantly any printed picture on to paper, cloth or dishes. Also transfers designs from magazines on to cloth ready to work or paint. Sometimes used for transferring advertisements onto glass for magic lanterns for advertising displays.

FORMULA.—One bar of common soap dissolved in one gallon of hot water, then add one-half pint turpentine. Let stand over night, stir well and bottle and it is ready for use.

Apply the solution to the picture with a small brush or your fingers, then lay a clean cloth or paper over the picture and rub with the bowl of a teaspoon quite hard, when the picture is instantly transferred. To transfer on glasses or dishes, first varnish the glass or dish with a white varnish and let it dry, then wet the picture same as before and lay the picture face down on the glass or dish and rub on the back of the picture. This will transfer the picture instantly on to the glass or dish.

TOOL FOR MOVING MACHINERY.

A wooden lever made of maple, having the square part 4 by 6 inches and from 9 to

A Wooden Lever

10 feet long will be found convenient for moving machinery, says a correspondent of Power. Such a tool can be used by one man to do work which ordinarily would require two or three. It will take the place of a jack.

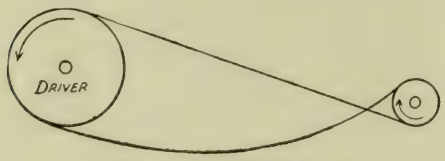
SOFT TOOLS FOR HANDLING MACHINERY.

For driving keys and other work about machinery a babbitt or lead hammer is better than a copper hammer which hardens the more it is used. To keep the lead hammer from getting out of shape, take a piece of copper pipe, iron pipe size, drill a hole in one side of it and fit with a handle and then fill in the hollow of the copper pipe with lead.

Even better than the lead hammer are hardwood blocks on end. Put against part to be driven and strike with a hammer. For driving the stub end of connecting rods on large engines back and forth when keyed up, use blocks about 5 inches square and 3 feet long.

CROSSED PULLEY BELT.

Here is a case of a crossed pulley belt. The more load there is on the saw, the more the sag on the lower side of the belt in-



How the Crossed Belt Runs

creases, until the belt contact on the small pulley is greatly increased, and the contact on the driver considerably lessened.

To produce a polished surface on turned work, soapsuds is one of the best lubricants. It should be fed continuously and lavishly upon the tool while cutting. The work must be carefuly dried and oiled when completed to prevent rusting.

TO PREVENT BRONZE CASTINGS FROM ADHERING.

A new method of casting bronze so that it will not adhere to the metal mold and tear away from the casting when forcibly removed, consists in adding metallic sodium, in the proportion of 1½ parts sodium to 100 parts bronze, to the tin of the alloy.

Heat the tin to from 400 to 435 degrees F., and the sodium separately to from 175 to 200 degrees F., excluding the air as much as possible. When the tin is at the heat specified, add the heated sodium. If the tin is more than 435 degrees, the sodium will ignite. When the alloy is cool break it into pieces. It may be laid away for future use if the casting is not to be made immediately.

To make the bronze, heat the copper to about 1,350 degrees F. (below melting point, to prevent the sodium volatilizing), and add the alloy in the right proportion. The alloy will melt and the copper begin to absorb oxygen, thus developing heat. Finally the copper will melt, the fusion of the alloy and copper will follow, and it may then be poured into the molds. During the pouring the remaining sodium goes off in fumes and forms a layer between the mold and the casting, which prevents the casting from adhering and causes it to come out in perfect condition. The coating on the casting, due to oxidized material, may be removed by immersing in dilute hydrochloric acid.

CLEANING GRAY IRON CASTINGS.

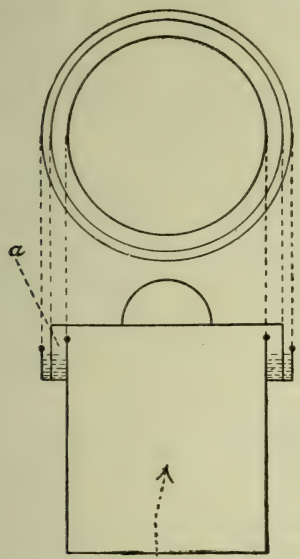
To clean scale from gray iron castings, pickle by immersing in water containing one per cent (not more) of sulphuric acid and let stand from two to three hours. Rinse in cold water and scour with sharp sand and a fibre brush, or with a coarse rag and the sand.

TO TEMPER MILL PICKS AND CHISELS.

Heat the bill to a dull red, and hammer until nearly cold; heat it again to the same color and quench in 3 gallons of water, in which has been dissolved 2 ounces of vitriol, 2 ounces of soda and ½ ounce saltpetre, or 2 ounces sal. amoniac, 2 ounces spirits of nitre, 1 ounce of vitriol. Set bill in solution until cold.

ECONOMICAL GLUE POT.

To prevent an insoluble film forming on the surface of hot glue when not in use it should be covered to exclude the air, thereby preventing the waste due to "skimming,"



GLUE POT.

An ordinary tight cover becomes stuck to the pot, owing to a small amount of glue which is sure to be around the edge of the pot, and which at the same time being uneven, prevents an air-tight joint. To overcome these difficulties I have had a pot made like the accompanying sketch, which explains itself. By filling the space around the pot at *a* with water the cover is perfectly air tight, and nothing prevents its easy removal at any time. The above is sent us by Frank W. Hobbs, Bangor, Me.

LIQUID METAL POLISH.

Take eight ounces of Spanish whiting, which must be perfectly free from grit, and put in one quart of gasoline. Shake up the whiting and gasoline thoroughly. You will notice the whiting settles immediately, leaving the liquid as clear as water. To remedy this, and further to make it a better polishing agent, add to each quart of the mixture 32 drops of oleic acid—no more, no less; shake again and the whiting will not settle. Apply to gold, silver, nickel, brass, glass or any kind of metallic surface with a piece of cotton flannel, rubbing well. Polish with a piece of same cloth.

HOW TO TURN CORK IN THE LATHE

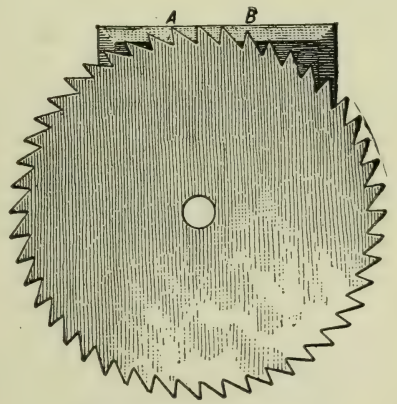
The natural structure of cork causes it to crumble readily, therefore it cannot be turned in the lathe in the ordinary way. However, it can be done by the following method:

First, set the cork revolving, then pass a rather coarse, sharp file over the cork, but at the same time let the file bear upon the tool-rest, or upon a piece of wood fastened to the latter. In this way, the cork will be abraded without serious tearing, and can be shaped as desired, and finished with a finer file.

The essential point is to touch the cork only while the file is in motion *forward*, and while the file is also supported by rubbing against the tool-rest. This support keeps the work running true, and also moderates the pressure upon the cork.

BEVELED BLOCK FOR SETTING CIRCULAR SAWS.

A block of cast iron having a different bevel on each of its four edges to suit the different saws is a good device for setting circular saws, says a correspondent of The Blacksmith and Wheelwright. The block should be about 6 inches square and 2



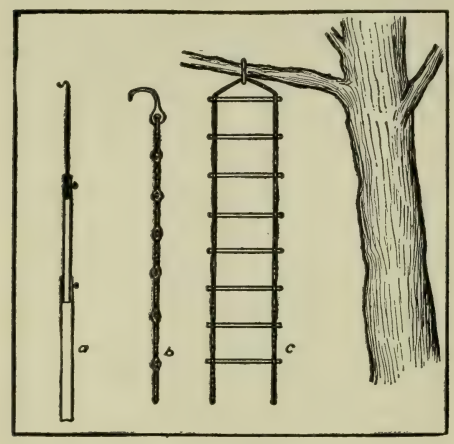
For Setting Circular Saws.

inches thick. Place the saw on the block of iron with the bevel to be used up and hit the tooth B. Use a small-faced hammer to set the teeth.

To soften paint brushes that have become hard, soak them in raw linseed oil for 24 hours, rinse in hot turpentine and repeat the process till clean.

HOW TO MAKE A HANDY ROPE LADDER.

Here is a ladder which, though originally designed for the use of linemen, is adapted to numerous pursuits. For a camping outfit or a nutting party it is just the thing, for it is so light it can be carried in the hand. A bow-shaped piece of iron holds the



A Flexible Ladder

sides of the ladder, and to it is attached an iron hook for hanging the ladder over a bough of a tree. The sides are made of rope with places at regular intervals for fastening in the rungs, as shown at b. A rod (a) for hooking the ladder over a limb is made of pieces of pipe held together with thumbscrews.

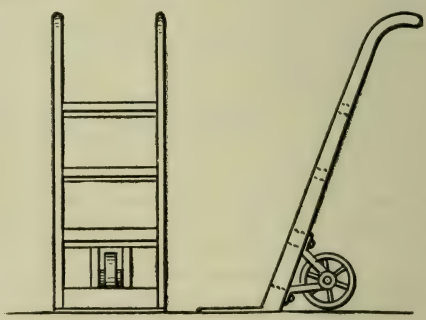
STEAM DOME ON BOILERS UNNECESSARY.

A stationary boiler is better without the steam dome, says the Practical Engineer. The steam dome is supposed to effect a drying of the steam and also add to the steam space of the boiler. Both of these purposes it certainly performs, so that it cannot be objected to upon the grounds of inefficient service. In the first place, it removes the outlet of the steam to a greater distance from the water surface, and consequently there is less chance of carrying water over to the engine when the boiler primes slightly. Being of comparatively large cross-section, the velocity of the steam passing through it on the way to the outlet is comparatively slow. This gives the moisture particles entrained with the steam an opportunity to fall out of the steam by mere action of gravity. However, there are other and better ways of securing the same result. The dry pipe is just as useful in obtaining dry steam as is the dome. It is merely a perforated pipe attached to the outlet, but lying wholly within the boiler. The areas of the perforations when taken together are considerably greater than that of the steam main leading from the boiler. The dry pipe is usually placed so as to extend along the upper part of the steam space and parallel to the longitudinal axis of the boiler shell. It thus draws steam from a large portion of the steam space.

Its main advantage over the dome, however, lies in the fact that its attachment to the boiler does not weaken the shell to any appreciable extent. In order to attach a dome, the shell of the boiler beneath the dome is cut away, thus removing a large amount of solid plate, making the boiler considerably weaker under the transverse strains set up, and also permitting greater distortion.

A ONE-WHEEL MILL TRUCK

A mill truck which has but one wheel, and consequently can be used on a narrow plank for loading bags from or to cars, is made on the same line as a wheelbarrow, says a correspondent of the American Miller.



Mill Truck with One Wheel

In many cases it will be found more convenient than a double-wheel truck, as an equilibrium can be maintained even on a rough path, where the double-wheel truck must of necessity tilt.

To prevent serious results from a wound caused by running a rusty nail into the foot or hand, smoke the wound with a woolen cloth. Twenty minutes of this treatment will cause all pain in the injured and inflamed part to cease.

BENDING SMALL PIPES.

A method of bending small pipe, the bore of which is not large enough to permit filling it with sand is given in The Model Electrician. The tube was cut off to the length

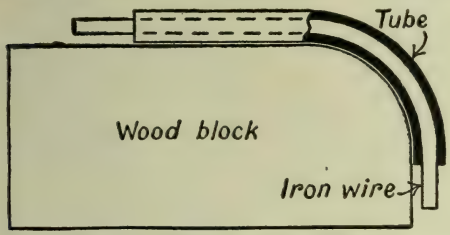


FIG. 1.—MAKING THE FIRST BEND.

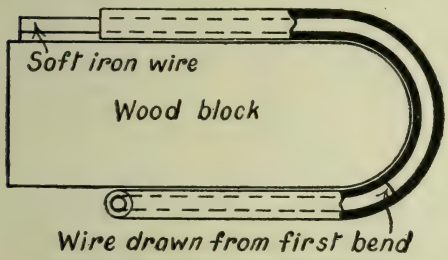


FIG. 2.—THE BEND FOR SYPHON PIPE.

to make a syphon pipe for a small pressure gauge, and a length of small soft iron wire was cut to a little longer than the tube and, the size of wire being just an easy fit in the tube, was then inserted into the latter. The first bend was made at the end where the pipe fits into the boiler, upon a wooden block, and then the wire was drawn out of the curve and the next one bent to shape, and then the wire drawn out. If both bends are attempted without drawing out the wire from the first curve, it will be difficult to withdraw the wire afterwards. In this way small tubes may be bent without damaging them in the least, whereas if the tube be bent without anything in the bore at all, it will surely become flattened somewhere.

COLORS USED IN TEMPERING.

One of our subscribers sends the following list of colors used in tempering. The Fahrenheit scale is used.

Lancets and razors, yellow, 430 degrees; straw, 450 degrees. Wood-cutting tools and taps, dark straw yellow, 470 degrees; yellow, 490 degrees. Chisels, hatchets, saws, etc., and percussive tools, brown yellow, 500 degrees; brown (slightly tinged), 510 degrees; purple, 520 degrees; light purple, 530 degrees. Springs, clear black, 570 degrees; dark blue, 600 degrees.

POWER REQUIRED TO RAISE WATER

Multiply the number of gallons per minute by 10 and by the number of feet the water is to be lifted, and divide by 33,000. Then add one-third for friction, or, if a considerable lift, or through more than two elbows, add two-thirds for friction.

For example, to raise 100 gallons per minute 25 feet through a pipe with two elbows: 100 × 10 gives us 1,000; × 25 is 25,000; divided by 33,000 gives us .757 horsepower, or three-quarters of one horsepower; to which add one-third (.25 or one-quarter horsepower) gives as the result, 1 horsepower.

MAKING LARGE WRENCHES IN EMERGENCIES.

For turning nuts on large unions where there is no wrench of a size suitable for the work in hand, it is not always necessary

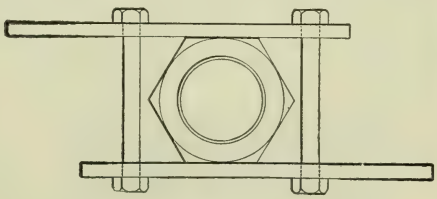


Fig. 1

to forge a wrench, says a correspondent of Power. For a brass union on a 2½-inch pipe take two pieces of iron about ½ by 2½ inches and 18 inches long and two ½-inch bolts. Bore holes for the bolts and screw up as shown at Fig. 1. The two projecting ends coming on opposite sides will serve as handles for turning. Friction is reduced by applying force on two sides of the pipe.

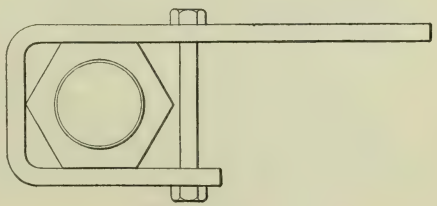


Fig. 2

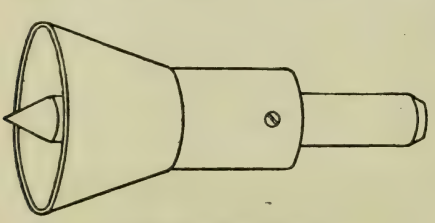
Where there is not room enough to use this wrench, heat a single piece of iron, beat it into the shape of Fig. 2 and join with one bolt. Turn by means of the long handle.

TO LOCATE FIRE ESCAPE IN FACTORIES.

A simple signal to show location of fire escape in factories is to paint one pane of glass red, on each floor, in the window opening on the fire escape. This not only serves as a guide to employes during the day, but if fire occurs during the night indicates to the fireman the location of the standpipes which are placed on the iron ladder.

A BELL-CENTERING PUNCH.

A bell-centering punch is one of the most convenient centering tools in use. It consists of a bell, or cone, which carries a center punch free to move up or down. A small screw put through the top of the cone so that its point comes in contact with a



A Bell Centering Punch.

flat filed on the punch keeps the punch from falling out. Hold the tool upright on the work and give the punch a sharp blow to obtain a center. The illustration is reduced one-third.

TO PREVENT RUST ON MACHINERY.

A good mixture for use as a slush to prevent the rusting of machinery is made by dissolving 1 ounce of camphor in 1 pound of melted lard; skim off the impurities and add enough black lead to give the mixture an iron color. After cleaning the machinery carefully, smear on the mixture. It can be left indefinitely, or if wiped off after 24 hours will prevent rust for some time. When removed, the metal should be polished with a soft cloth.

CARBOLIC ACID FOR TEMPERING STEEL TOOLS.

M. Levat (a Frenchman) recommends carbolic acid for steel tools, claiming more elasticity and pliability than is derived from tempering with water.

TO TRANSFER PICTURES TO GLASS.

Clean your glass thoroughly and varnish it with a clear white or nearly colorless varnish. Put it where it will be clear from dust and let it stand over night. Then take your picture, lay it in clear water for ten to twenty minutes, or until thoroughly wet through. Then lay it carefully upon a piece of blotting paper, so that the moisture may dry from the front and leave the back still wet. Now at once varnish your glass the second time; then place the engraving face down upon the varnish and press down firmly, excluding all the air bubbles. If you have one, it would be well to use a rubber roller, such as photographers use, to press the picture to the glass and exclude all air bubbles. Then rub lightly the paper from the back until transparent and even, then varnish again and dry.

TO CUT SKY LIGHTS.

An ordinary soldering iron is the best to use for the work. Make a notch in the edge of the glass with an ordinary file for a starting place. Heat your iron good and hot and pull it slowly back and forth over the line to be cut and when the line commences to open, keep the iron one-fourth inch ahead of the cut. Keep iron very hot and use point and corners of it.

A GOOD TEMPERING RECIPE.

For small drills, chisels, etc., for very light work, says W. F. Smith of Baltimore, heat to a dull red and cool in a bar of common soap. The temper will be about right and no drawing will be required.

REMOVING INK SPOTS ON MARBLE.

Ink spots on marble may be removed with a paste made by dissolving an ounce of oxalic acid and half an ounce of butter of antimony in a pint of rain water, and adding sufficient flour to form a thin paste. Apply this to the stains with a brush; allow it to remain on three or four days and then wash it off. Make a second application, if necessary.

To find the width of a belt for any required horsepower, multiply 33,000 by the diameter, and then divide the product, first by the length in inches covered by the belt on the driven pulley, and then by half the belt speed in feet per minute.

HOW TO BORE HOLES IN GLASS.

Take an old three-cornered file, one that is worn out will do; break it off and sharpen to a point like a drill and place in a carpenter's brace. Have your glass fastened on a good solid table so there will be no danger of its breaking. Wet the glass at the point where you wish to make the hole with the following solution:

Ammonia	6½ drachms
Ether	3½ drachms
Turpentine	1 ounce

Keep your drill wet with the above solution and bore the hole part way from each side.

Still another way, is to dissolve a piece of gum camphor the size of a walnut in one ounce of turpentine. Use as above described.

ANOTHER METHOD.

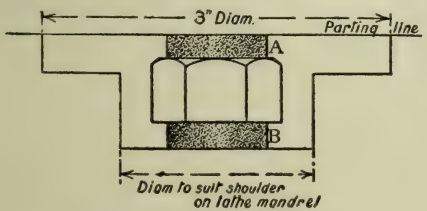
is sent us by a reader who has used the plan for years with perfect satisfaction. He says:

For drilling glass use a steel drill hardened, but not drawn. Saturate spirits of turpentine with camphor and wet the drill. The drill should be ground with a long point and plenty of clearance. Run it fast and feed light. In this manner lubricated glass can be drilled with small holes, up to 3-16 inch size, nearly as rapidly as cast steel.

A FACEPLATE FOR SELF-CENTERING CHUCK.

A self-centering chuck of use to those who have not the necessary screwing tackle, may be made as follows, says a correspondent of The Model Engineer:

Get a good hexagon nut to fit the lathe mandrel, and file the flats up a little, then make a pattern like sketch, allowing 3-16 inch all over for machining. Out of a piece of Bath brick, cut two washers (A and B)



Faceplate for Self-Centering Chuck

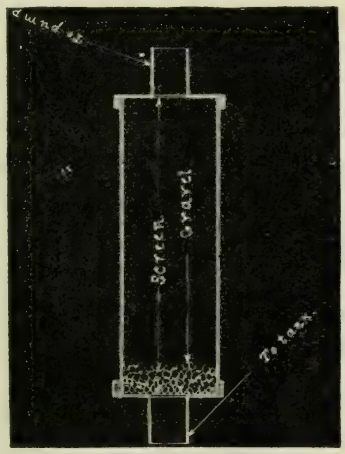
exactly ⅜ inch thick, and ¼ inch larger than the tapped hole in the nut. Then glue the washers centrally one on each end of nut, wiping any excess of glue away.

Place the nut in center of the mould, so that the metal envelopes the nut, excepting the ends covered by the washers. The writer says he has made three such himself, one for a 3-inch self-centering chuck, and two for emery-covered wooden disks. These were made out of some white metal, purchased cheaply. The Bath brick washers were then scraped out of the casting, which was then screwed on lathe mandrel, faced up, then reversed and treated in like manner.

TO MAKE A GASOLINE STRAINER.

To make such a strainer as is shown in the cut, simply take a piece of common iron pipe five or six inches long and one inch in diameter, threaded at each end.

Obtain a cap which will screw on each end of the pipe. Now drill a hole in the center of each cap and tap to fit pipe used in connecting up the pump with the engine.



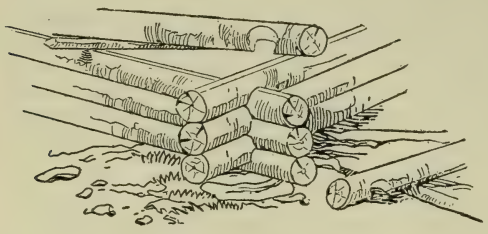
Gasoline Strainer

Cut a piece of fine screen the same size as the inside of the cap. Place the screen inside the cap and screw in the pipe. Next fill the pipe with fine clean gravel (gravel not to be larger than 1-16 of an inch), place the other screen in position, screw on the cap, and the strainer is complete. Place the strainer between the pump and tank.

Have you seen "Shop Notes"?

Permanent Camps and How to Build Them

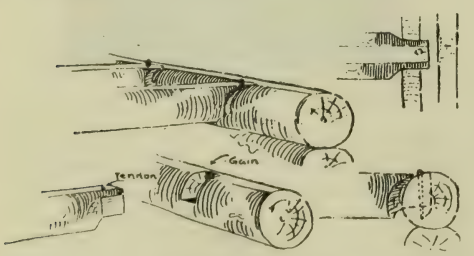
No place could be more picturesque and cozy than the log cabin camp, especially where care in choosing its site has been exercised.



How the Logs Lock at the Corners

Aside from the boating, hunting and fishing advantages of the camp's location, the scenery surrounding it should be considered; it should not be near a swamp, but on high dry ground and, if possible, near a running stream, but always near pure, fresh water. Plan the building to harmonize with its site.

Clear away all decayed trees which might fall on the cabin, stake out the structure according to the plans and clear off the place it is to occupy. For foundation posts use cedar if possible; if not, tamarack, pine or hemlock. Select sound timber about 12 inches in diameter and 5 feet long. Dig post holes down to solid ground or rock, or about 3 feet deep; set the posts, tamping the earth firmly around them. There should be a post under each angle and corner of the building and where these are quite a distance apart, as many in between as necessary. In a distance of 20 feet there

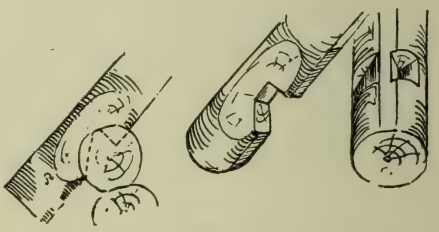


Framing the Joists

should be four posts, including those at the corners, and in 12 feet, three posts. After the posts are set, mark the one in highest ground 10 inches above the ground and cut off squarely. Cut all the others, save those at the ends between the corner posts, on a level with the first one. Those at the ends between the corner posts cut 4 inches higher.

Stone foundation piers, instead of posts, may be made by digging pits 3 feet deep and 2 feet in diameter, filling them up with small stones to ground level and laying large cobble-stones on top of these, chinking up with small stones any places that may remain open.

For building the cabin use straight, sound timber from 6 to 10 inches in diameter. Tamarack, balsam, pine, spruce and hemlock are all good for the purpose. Each log should be cut two feet longer than the side of the building in which it is to be used is to be. Where the tops of the trees are straight and sound they may be used for rafters, joists, etc. If the timber is brought



Framing and Beveling the Rafters

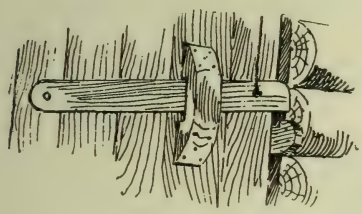
some distance to the building site, it should be placed on skids (two logs) and thus hauled to camp.

For the first tier of logs select the strongest, best shaped and largest of all. These sills, as they are called, should be flattened on the upper side from end to end and in a straight line, and at the narrowest part of the log the flattened space should be 3 inches wide. Place them on the foundation piers so that the flattened surfaces are level with each other. All the other logs for the walls flatten on both sides. When the sills are laid cut notches in the logs and lay the floor sleepers.

To join the logs at the corners, on the under side a foot from each end cut a hollow which will fit over the round side of the log beneath. Place the logs so the large and small ends of them come alternately. Lay the logs carefully, being sure that each log is properly laid before proceeding with

another. Continue laying the tiers until the height of the tops of the windows and doors is reached. At this point saw out the top log the proper width of each window and door to be made, lay the next tier of logs and then resume sawing out the openings for windows and doors.

Have ready door and window frames made of boards 1 inch thick and planed on one side. Nail them in the openings to

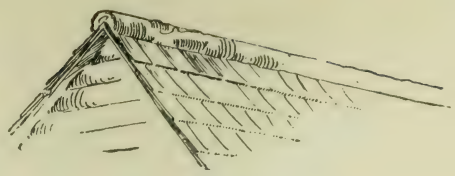


The Door Latch

hold the loose ends of the logs. Make the window sills slanting so they will shed water.

If there are to be two floors to the cabin, at the height of the second floor lay peeled joists, which should be of straight sound timber 6 inches in diameter if the span is 12 feet; thicker if the span is longer. Always place them so they will have the shortest span possible and about three feet apart. Flatten their upper sides from end to end, using a chalk line and a broad axe for the purpose. To place the joists cut gains, as shown in cut, in the logs that receive the joists and make tenons on the ends of the logs. Use spikes to fasten them. Where partitions are to run the same way of the joist, place a strong joist under each one. At openings for stairs cut

Partition Made of Halved Logs



How the Roof Should Look

the joists at the proper places and put a crosspiece between two joists across the cuts, joining by means of gains and tenons as before.

In putting up the rafters raise the gable rafters first. The best roof is a steep one. Select and flatten the rafters just as you did the joists. Frame their lower ends to fit the plate-logs and bevel their tops according to the slant of the roof. Use a ridge-pole to fasten the rafters to at the top. Lay them about three feet apart, spike them to the ridge-pole at the top. Select small timber about 4 inches in diameter, flatten one side and halve them on to the rafters, letting them extend over the gable ends about 6 inches. Nail them in place.

If shingles cannot be procured for a covering, bark will do very well. The bark

Crosspieces Where Joists Are Cut for Openings

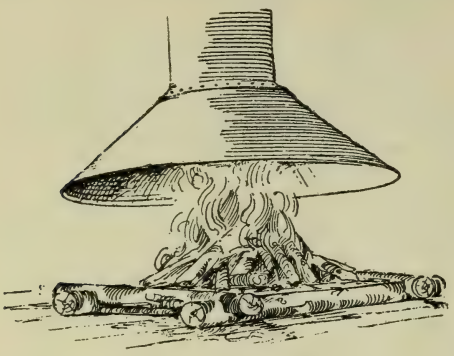
should be removed from large trees and laid on in long strips, overlapping 6 inches.

For floors use matched and planed pine boards 1 inch thick and 6 inches wide. For the second story floor they should be planed on both sides, unless two thicknesses are used, in which case the boards should be put on with the rough surfaces facing.

To make partitions saw logs in longitudinal halves, and nail them in form with their flat sides facing and overlapping just enough to hold firmly when nailed together. This will make each side of the partition consist of a round log surface and a flat one alternately. Place a log on top of the partition and spike into place.

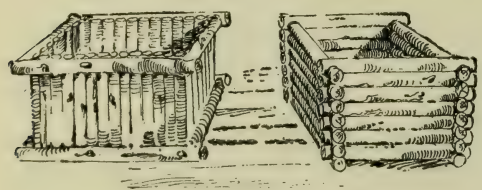
Window sash must be procured from some outside source of supply and they should be placed in the frames so they

will be waterproof. Windows that swing out are most convenient. Straps of old leather will do for hinges and a hardwood bar on the sash, having holes bored



A Funnel Fireplace

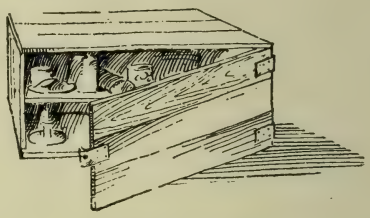
in it to fit over iron pins in the frame will be convenient for holding it open, while a a leather strap to button over the nail will hold it closed. Make doors of matched boards and use braces and crosspieces on them, nailing them securely. If hinges are not to be had, bore a large deep hole at one side of the door in the upper part of the frame, and another directly opposite in the lower part of the frame. In these holes slip the ends of a strong round stick which will turn in them easily. Nail the door on one side of the pole. To fasten the door make a wooden catch and provide a strong bar to work as a latch. Fasten a string to



Two Ways of Building a Wood Box

the latch on the inside and pass it through a hole in the door to the outside. Screens add much to the comfort of a cabin and may be provided if desired.

The fireplace should be built up with the cabin, laying stone foundations for it at the time the other foundations are laid, using cement mortar. The fireplace should be of firebrick, but may have a stone face. The opening should not be larger than 3 feet high and 5 wide and be arched at the top. The fireplace should have a deep throat and the smoke flue should be about 16 inches by 16 inches. Build the chimney of brick, and to prevent the roof from leaking around it lay pieces of tin in the brick work, letting one edge extend under the shingles at the top side of the chimney and over them at the lower and at the sides let the tin turn down against other pieces laid with the shingles. If the chimney reaches above the ridge-pole it will have a good draft without capping it over, but if below the ridge-pole it should be capped. The fireplace may be built up in a ledge to support a mantel, or wooden brackets may be made. A crane may be made by bracing an iron bar to an upright piece. Sockets for

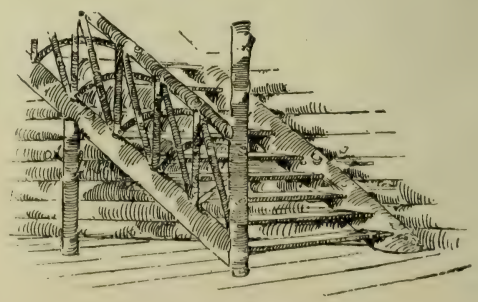


A Packing Box Cupboard

the crane should be built in with the brick and the vertical piece should have pins to fit into them. The arm should be provided with hooks, on which to hang vessels, etc.

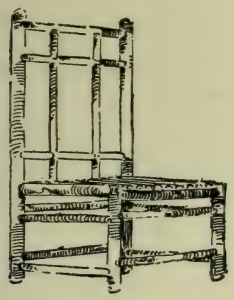
Another kind of fireplace consists of a huge inverted sheet-iron funnel 3 feet wide at its lower part and tapering up to fit the smoke pipe about 12 inches in diameter. The top of the pipe extends above the roof; the funnel is suspended over a foundation of stone, brick or clay 8 inches deep and which supports the firebed which is held together by a frame of green logs. This is a good arrangement for warmth.

In building a stairway the frame is built of poles, and as to the work put on it, one

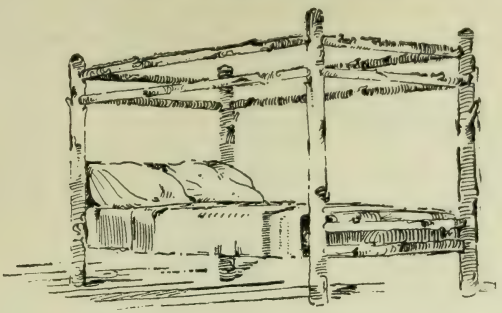


A Rustic Stairway

may suit his fancy. Halved logs may be used for steps and are convenient for many other purposes.



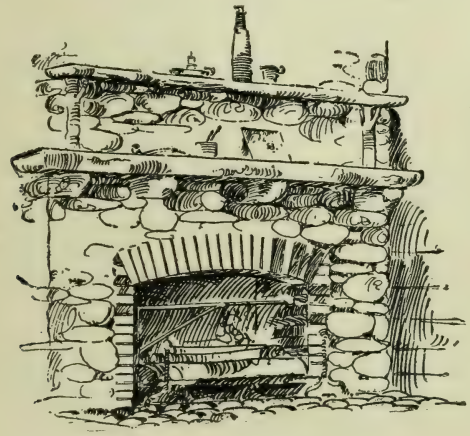
Made of Green Saplings



A Canopied Couch Built of Small Poles

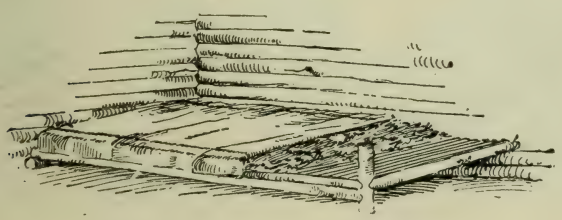
Bunks may be made by placing small straight even poles on a frame work of poles at least a foot above the floor and laying even-sized boughs and fine twigs to the depth of two feet, laying pieces at sides, head and foot to hold the boughs in place and on these laying the blankets or sleeping bag. A packing box can be used for a cupboard by hinging its cover and furnishing with a few shelves.

For furnishings for the cabin there is a wide range for suiting individual tastes. Many articles, such as chairs, beds, wood boxes, tables, etc., may be built of poles and nails. Window seats add to the appearance of comfort and rustic seats can be built for the veranda.

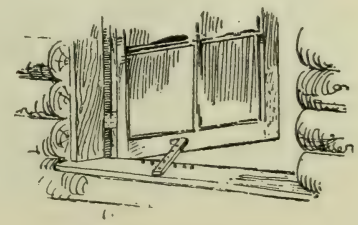


The Fireplace with Rustic Mantel

For the disposal of garbage it is well to dig a hole a little distance from the camp,



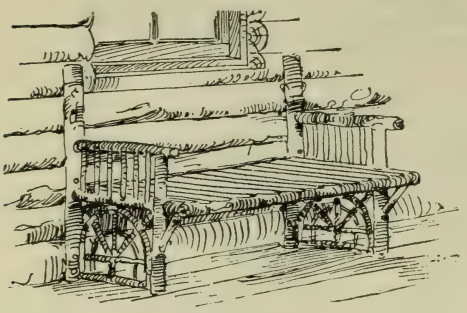
Bunk With a Mattress of Springy Boughs



To Hold the Window Open

sprinkling a little of the excavated material over any refuse that is placed in it.

The cabin may be finished more inside if thought best, but this detracts rather



A Cozy Window Seat

than adds to its appropriateness. Calking should be done as late as possible, so the logs can dry out a little. For calking use oakum or moss, pressing it in between the logs from both sides, using a wooden chisel and a mallet to force it in. Care in the details of the camp will afford a place as inviting and comfortable as can be desired.

"PUSH-BALL ON HORSEBACK," A NEW ENGLISH GAME.

"Push-ball on horseback" is a new game which was in high favor at the Royal Military Tournament held in England recently. The game was played with an enormous ball by troopers of the Royal Horse Guards splendidly mounted on black horses, three mounted men on each side of the ball. The game consists in the horses pushing the ball about with chests and knees, but the interesting feature of the game is the admirable horsemanship of the participants which has room for fine play. After a time the horses enter into the sport with great zest and appear to enjoy it as much as the men. The game originated with a circus in Germany. The ball, which is four feet in diameter, is covered with leather and inflated like a football.

OILED ROADS IN CALIFORNIA.

A single county in California has 145 miles of oiled highways. The location is near oil fields and the country is quite level. In constructing the roads the roadbed is first graded and rounded slightly and then it is sprinkled with the oil. An ordinary wagon tank is used for this purpose and is provided with a piece of 4-inch gas pipe 10 feet long and having half-inch holes drilled in it two inches apart to serve as a distributer. The oil is applied to a width of about 10 feet. It is then gone over with a harrow and thoroughly mixed. It is applied in hot weather and about 100 barrels per mile are used in the first application. It is then allowed to stand two weeks and then a second application of about 50 barrels per mile follows.

About 50 barrels per mile are used annually to keep these roads in repair at about 25 cents per barrel for the oil and from 30 to 45 cents per barrel for applying it. These roads are fine for driving, but the odor is disagreeable.

Pushball on Horseback

First Lessons at the Forge

Every young man, no matter what his intended occupation or profession, should know something about forging, welding and shaping metals. The work is at once fascinating, useful and practical. This series of articles will extend through several issues.

PART III.—BENDING, SWAGING AND WELDING

By A. W. Marcy,

Having learned the principles of forming and welding described in the previous chapter, the useful every-day articles will be next in order. The chain links described in Part II if made into a chain will necessarily need a hook on one or both ends.

The hook shown in Fig. 24 is the style generally used on common chains, and is made in different ways. For small chains of ¼ or 5/16-inch links, the method shown in Figs. 25, 26 and 27 is the easiest and quickest. A piece of round iron, a little larger than the diameter of the link which is to hold the hook, is swaged three or four inches from the end to the size of link used, as in Fig. 25. The swaged portion should be just long enough to form the eye when bent to the shape of Fig. 26. Weld the two pieces together as shown in Fig. 27, and punch out the eye large enough to allow the link to work easily. The round shank near the eye should be quite a little larger than the diameter of the link used. Cut off the long end and weld the two ends together, drawing the point down tapering, and leaving the center as large as possible. It is then bent to the shape of Fig. 24, and flattened as shown at A, which spreads the stock out wider, making it stiffer and less liable to straighten.

In making large hooks, select a piece of iron large enough for the largest part of hook, and bend from an inch and one-half to two inches over the corner of the anvil, as in Fig. 28, and hammer it down endways as in Fig. 29. Take a welding heat and weld down solid; punch a round hole in the center and swage down the shank near the eye. Round up the eye on the horn of the anvil by placing the eye on the point of the horn and striking on top with the hand hammer. Another method used largely for steel hooks is to upset the end of the bar sufficient to produce the eye, and proceed as just described. When bent to shape, the draft of the hook should be in a straight line with the eye, as per dotted line B in Fig. 24. Fig. 30 shows a meat hook for holding beef, which is made of round iron, drawn to a sharp point for the hook, and the shank flattened and bent to shape. The sharp corners can be bent in the vise or over the corner of the anvil as preferred.

Fig. 31 shows a coat and hat hook, which is made of ¼-inch round iron about 6 inches long, each end swaged down smaller to within one-fourth of an inch of the end, which leaves a knob. This knob should be rounded up over the corner of the anvil to a well shaped ball. The flat part is hammered down, two small holes punched for screws, and the hook bent to shape.

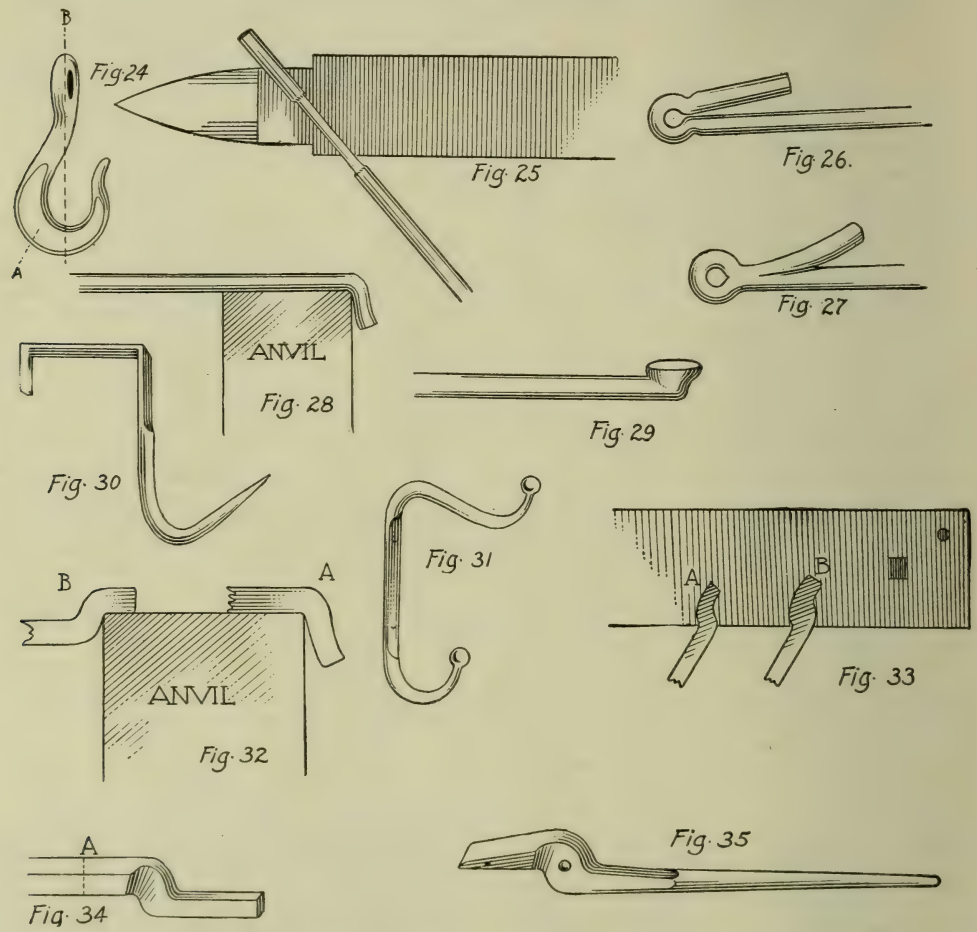
Nearly all kinds of bolts can be made with the aid of different sized heading tools. These tools can be bought of any dealer in blacksmiths' tools, or the amateur smith can make a few himself which will answer the purpose. Steel will be necessary for these, as iron is entirely too soft. A piece of an old wagon spring, a short piece of steel wagon tire, or a piece of a light steel axle will do very well for heading bolts up to ⅝ inch in diameter. Twelve inches is about the proper length for small sized heading tools, larger and heavier sizes being as much longer as desired. Select a round punch the size of hole desired; heat one end of the steel to a medium bright red, and punch the hole nearly to the required size, then drive the punch in from the bottom side, swelling out the bottom until the top side of the hole is a trifle larger than the bolt to be made, being sure the top side is smooth and level, and the bottom side of the hole larger than the top. When heating steel of any kind more care is necessary than in heating iron, as steel will not stand as high a heat.

It is not safe for any but experienced smiths to heat steel above a bright red heat, and the smith who heats steel for the first time should use considerable care, and remember that a fairly bright red is sufficient. In making heading tools of flat

stock, a different sized hole can be punched in each end which makes one tool equal to two. Bolts are usually made by upsetting the stock to form the head, and in cutting off the iron for a bolt for a given length, sufficient stock must be allowed extra for the head, the amount depending upon the size and shape of head desired. A few trials will soon enable one to judge the amount required.

To make a complete bolt it is of course necessary to cut a thread on the opposite end for the nut; this the amateur will be unable to do without thread-cutting tools for this purpose, but the knowledge and practice gained by making the bolt heads will be worth the effort. The same methods can be used to make heads on rivets and pins.

Another method, sometimes used for making heads on bolts, is to drive a common nut on the end of the rod, and weld the two together. This is not as good a method as upsetting, but does very well in an emergency on large sized bolts.



The upsetting of a bolt smaller than ¾ inch can best be done by screwing it in the vise, and striking the hot end with the hand hammer. When upset sufficiently, heat to a good bright red, place in the heading tool and drive it down until the head is the desired thickness; drive out of the tool and square or round up the sides as desired. In making a number of bolts of the same size, upset each one alike so as to have the heads the same size.

As the young smith progresses with his work and tries a larger variety of jobs, he will be unable to securely hold the different sizes with his one or two pairs of tongs, and will feel the need of a few extra pairs. There are several methods of making

tongs, but the easiest for the beginner is as follows: For light tongs 5/8-inch or 3/4-inch square stock is large enough. The end of the bar is first bent over the corner of the anvil as shown at A Fig. 32; a second bend is made as shown at B. It is then placed on the anvil as shown at A Fig. 33, and flattened out as at B for the eye; the end at B is swaged down for a stub shank and will now look like Fig. 34. The end of the stub is scarfed and a 3/8-inch round rod welded on for a handle. The jaw is then cut off at dotted line A Fig. 34, drawn down to the proper shape, and the hole for the rivet punched, which completes the piece as shown in Fig. 35. Two of these pieces are necessary for a pair.

When riveting, the parts should be placed together, the rivet heated red hot, thrust through the hole and headed on both sides. This will probably leave the tongs fastened tightly together, but they are easily loosened by heating red hot and opening and shutting a few times. When the tongs are red hot after riveting together, place a piece of 1/2-inch or 5/8-inch round iron between the jaws and hammer the jaws nearer together, which will form a crease in the jaws for holding round iron. The hardy which the young man uses will become quite dull from constant use; the grindstone will help this to a certain degree, but if dulled very much, it will need "redressing," which is done by heating, hammering and tempering. The "bit" or cutting part should be heated to a medium bright red for an inch and one-half, and hammered out flat to an edge, as when new. If more than one heat is necessary for this, lessen the heat each time until the last hammering or finishing is at a low red. When drawn out, lay aside to cool, and when cold, take to the vise and with the flat mill file, file each side to an edge, being careful to have the edge straight and not too thin.

When filed up, it is ready to temper; but before tempering, the fire should be well packed down with charred coal, a pail of clean cold water obtained, also a small piece of sandpaper or emery cloth.

To heat for hardening, lay the bit on top of the fire, and heat slowly and evenly to a low red, commonly called a "cherry red." The heat must be even, with no hot or cold streaks, and should extend about an inch back of the edge. When at this heat, stick into the cold water for about an inch and one-half, gradually moving it around and up and down. When cold remove and wipe off the water, and polish off one side with the sandpaper, but do not polish too much, just rubbing it bright is sufficient. Hold the bit over the fire, polished side up, and do not blow the fire at all; as the bit gets hot the color will begin to show; when at an even deep blue, cool off and it is ready for use. Constant care is necessary, in heating all steel tools, to heat slowly and evenly and not above a bright red at any time.

The heating, hardening and tempering of a cold chisel, prick punch, or screw driver is practically the same as for the hardy, the same rules applying to one as well as to the other.

In using files there is a right and wrong way as in everything else; the right way is a steady even stroke in pushing, and lifting clear off the work on the return stroke. The cut of a file is on the forward stroke, and unless the pressure is relieved on the return, the teeth will drag and crumble off, soon wearing it out.

Very little pressure is necessary to make a new file cut, but as the file wears, more should be gradually applied, until it slips and will cut no more. Riveting, whether hot or cold, should be done with a light hammer and medium light blows, as a blow from a heavy hammer upsets the rivet too far down, the upsetting of the end only being sufficient. For all ordinary riveting the 1-pound cross pene machinist's hammer is heavy enough. In performing the different operations described in this series of articles, the amateur will, and must expect to meet with failures, but patience and perseverance will overcome them.

LARGEST GASOLINE LAUNCH IN THE WORLD.

The "Edithia," the largest gasoline launch in the world, is 114 feet long on deck, 103 feet long at the water line, 15 feet 10 inches beam, with 5 feet draught. It is equipped with two 300-horsepower engines and can carry 2,500 gallons of oil. The boat has quarters for eight men, sleeping berths, dining saloon and pantry, and is handsomely finished in mahogany and satinwood. It is rigged with a stack and signal mast. The owner of this launch will use it as a high-speed cruiser between New York and Narragansett.

A PERFECTLY EQUIPPED INSPECTION ENGINE.

One of the most perfect inspection engines in the country is owned by the Burlington and Missouri River Railway. The front end of the 8-wheel engine on which the inspection cab is built rests on coach springs A Pullman car is not more handsomely or conveniently fitted up than this inspection car It has hot and cold water, a wardrobe, steam coils across the front for heating, etc Wherever it is exposed to heat from boiler or smokestack it is heavily lined with asbestos fire-felt. Rubber matting covers the floor and steps and the cab has electric lights; it also carries a powerful electric headlight. Its seating capacity will accommodate 15 persons and the inspector, whose head is but four feet above the rail when seated, has a fine view of the track. The engine can be handled from either the front or rear cab.

Inspection Engine for the B. & M. R. Ry.

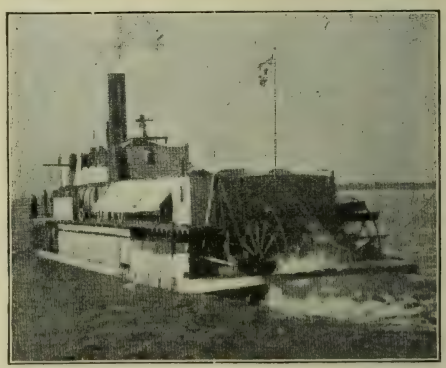
GUNBOATS SHIPPED LONG DISTANCE.

Three gunboats, constructed and erected in a yard on the Thames, England, were then marked, numbered and taken to pieces and shipped by several steamers from London to Alexandria and Port Said, and thence conveyed up the Nile by train to Kosheh, where they were again put together without a single important piece missing. The distance they were shipped was over 4,000 miles

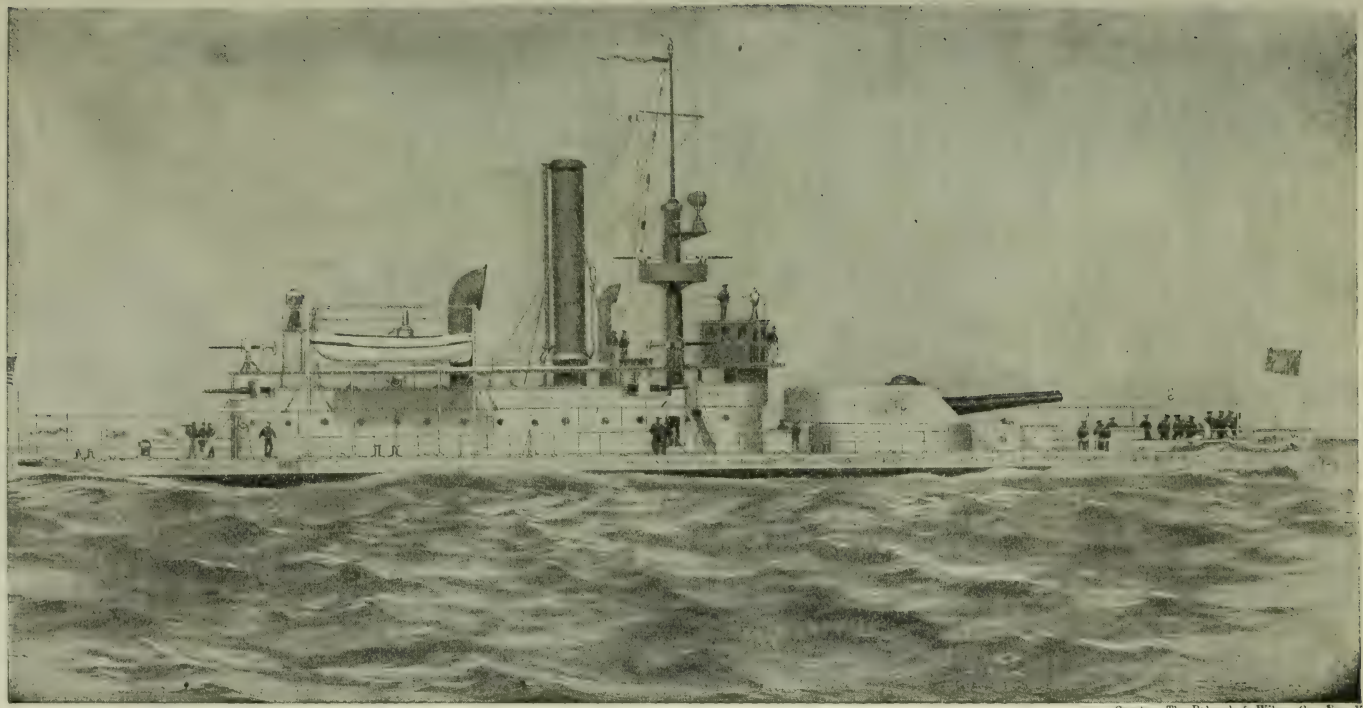
An English paper describes the boats thus.

"The hulls were built of steel in ten sections, for convenience in transport, and were of the following dimensions: Length, 140 feet; breadth, 24 feet, depth, 54 inches; with a draught of water of 24 inches. They had three teak decks, the main, upper, and battery, and above the battery deck was a protected conning tower, some 30 feet from the water-line, which sheltered the steering gear and telegraph, a powerful electric search-light, and two maxim guns. The hatches to the main deck were arranged to lift outwards so as to form shields for the infantry, shutters being provided to fire through. The armament consisted of one 12-pounder and two 6-pounder quick-firing guns; one howitzer and 12 maxim guns. The guns were served in action by an inner protected lift, and a protected ladder led to the magazines.

"The machinery consisted of one set of horizontal direct-acting compound surface condensing engines, indicating 400 horse-power. Steam was supplied by two steel loco-marine boilers working at a pressure of 150 pounds per square inch. The boilers were placed forward and the engines aft, and a speaking tube connected them. The names of the three gunboats are, 'El Zaffir' (i. e., Victorious), 'En Nazer' (i. e., Majestic), 'El Fateh' (i. e., Conqueror.)"



Stern-Wheel Gunboat, El Fateh, Shipped in Parts Over 4,000 Miles.



Courtesy The Babcock & Wilcox Co., New York.

The United States Monitor "Wyoming"

The monitor "Wyoming" was one of four vessels constructed by the Government for harbor defense. Her dimensions are: Length over all, 255 feet; beam, extreme, 50 feet; draught 12 feet 6 inches. Her armor consists of a heavy water line belt extending full length. Her conning tower is 7 1-2 inches thick, and an armored tube 3 inches thick, carrying telegraphs, wheel-ropes, etc., leads from it. The vessel's maximum speed is 14 1-4 miles per hour.

Cut this out and paste it in your hat as a reminder that **"We Told You So"**

The Way to Wealth is as Plain as the Way to Market. It Depends Chiefly on Two Words: "LINCOLN CONSOLIDATED"

THE LINCOLN CONSOLIDATED MINING COMPANY owns the absolute title to thirty-one of the best mining claims in the territory of Arizona, comprising more than 700 acres, and entirely covering two mineralized spurs of the Santa Rita Range of mountains, where the ore croppings are rich enough to ship to the smelter from the very grass roots.

The Company owes no debts, has no salaried officers and no office expenses of the Company. There is no promotor's stock. This proposition we submit bears upon its face the evidence of having less "water" and "hot air" in its make-up than any other mining proposition ever submitted to investors.

In the Chicago Tribune of July 2d is an article copied from the New York papers, stating that Senator Clarke of Montana owned the most costly house in New York City, and that his income from his Arizona mines was more than a million and a half a month. Mr. Sturtevant, one of our directors, who is familiar with The Lincoln Consolidated and with Clark's United Verde of Arizona, says that it is the opinion of mining engineers familiar with the surface indications of both properties that the Lincoln Consolidated bears the ear-marks of being the most valuable property of the two.

We are offering a limited amount of treasury stock (full paid and non-assessable) at 25 cents per share, and we believe that you are deliberately resisting prosperity if you ignore this golden opportunity.

***The* W. B. KIRTLAND CO.**

Fiscal Agents, 153 La Salle St. CHICAGO, ILL.

Ivy or Oak Poisoning

immediately relieved and quickly cured by

Hydrozone

Harmless, although a most powerful healing agent.

I will send on receipt of 10 cents to pay postage,

A Trial Bottle Free.

Send for it now. It will immediately relieve and promptly cure **Insect Bites, Hives, Prickly Heat, Sunburn,** etc.

Sold by leading druggists.

None genuine without my signature.

Prof. Charles Marchand

L-63 Prince St., New York.

Send for Booklet on "How to treat diseases," containing hundreds of testimonials of wonderful cures.

DRUG FISH TO CATCH THEM.

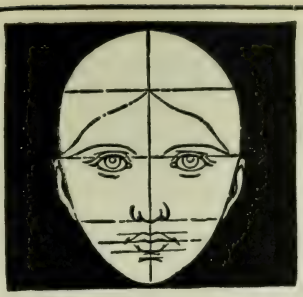
Fishermen in the vicinity of St. Paul are feeding croppies poisonous fish berries in order to render them unconscious so they may be easily caught. The berries are encased in small dough balls which are scattered over the bed of croppies. The fish are greedy for the food and the poison, while having no lasting effect, renders them unconscious for a time, so that they float on the surface of the water and may be picked up.

The practice is a most unnecessary one, the game wardens say, as when fish will take the dough balls they will bite bait on a hook just as well.

SEWED UP HIS HEART.

The most remarkable surgical operation in recent years was recently performed on Edward Pelt, a Chicago office boy, who, because he had lost his position shot himself, the bullet passing through the lung, tearing away much of the tissue and cutting a wide gash at the extreme lower part of the heart.

With blood flowing from the wound, and his strength rapidly waning, the boy was rushed to a hospital. There was but one slight chance of life for him and the attending surgeon took it. On the left side close to the breastbone three ribs were cut through by means of chisels. These ribs were broken, also, at the extreme left side. The flesh was cut on each side of them and laid back like a trap door, revealing the wounded and faintly beating heart. During the slight pauses between beats the surgeon applied his instruments, quickly, surely, until six stitches had closed the wound. Then the tissues of the lung were drawn together and the flap of flesh and ribs laid back over the opening and fastened down. Nearly two weeks have passed since the operation, and the boy has a good prospect of living.



WHAT $1 Will Do

One Dollar, if sent at once, will bring you a copy of

"How to Illustrate"

A PROFUSELY ILLUSTRATED SELF-INSTRUCTING BOOK

on an entirely new plan—by Charles Hope Provost, *artistic contributor to high-class magazines and weeklies everywhere—teacher of 4000 people by mail—originator of correspondence art instruction*

1. It will bring a complete and practical course of art instruction right into your own home.

2. It will not only tell you what is necessary to become a successful illustrator but will show you how to do it.

3. It will instruct you in the practical points of illustrating from the professional standpoint, which few, even the graduates of our best art schools learn, until, often too late, they are taught by experience.

4. And finally it tells you how to sell your work after you've learned how to produce it.

CONTENTS.

TECHNIC—Working with pen, brush (oil and water color), pastel, grease and conte crayon, lead pencil, carbon pencil, scratch paper, chalk plate, Ben Day machine, silver print work, etc. Also the various effects used by pen artists, including quick and slow lines, English and American styles of treating zig-zag lines, hooked lines, quick lines, double cross hatching, stippling, spatter work, etc. Wash drawings, Distemper drawings. Tracing and copying photographs. What materials to use, including papers, canvases, and bristol boards. Tools and how to handle them. Drawing from nature. Drawing from memory, with table showing comparative measurements of different parts of the human body—head, hands, feet, legs, arms, etc. COLOR—primary and secondary colors, etc., explained. How to mix different shades, etc. ARTISTIC ANATOMY—The bones and muscles as applied to pictorial work. LETTERING—Copying and originating, Roman, block, old English, and script styles shown. Elementary, historic, and geometric ornament. Conventionalization of flowers, ornamental composition, pictorial composition. FACIAL EXPRESSION—Sorrow, joy, anger, fear, contempt, laughter. Aerial and linear perspective. BUSINESS DETAILS—How to sell pictures, how to get a position as an artist, prices and salaries paid, lists of names of publishers and others who buy work, how to pack pictures to send by mail or express, etc., etc. Explanations of various engraving and reproductive processes.

"How to Illustrate" sent prepaid to any address in the world for $1.00. (Limp Covers.) A more handsomely bound edition in cloth covers, $1.50 prepaid.

THE ART OF CARICATURE,

a handy book (complete in itself on this subject) and containing specimens and explanations of all kinds of caricature, from the simple work of the student to the finished drawings of the best artists. Prepared by a professional artist of twenty years' experience. Nineteen pages of diagrams and illustrations. A 12-page supplement sent with this book is alone worth its price.

PRICE 50 CENTS A COPY, POSTPAID or by combining with order for "How to Illustrate" may be had for 25 cents.

Remit to-day as this offer may be withdrawn at any time, or send for free descriptive circular.

BROWN PUBLISHING COMPANY

Room 901, 114 Fifth Avenue, New York

Remit by Express, P. O. Money Order or Registered Letter.

THE SHRINE OF LOVE

A Neat Monthly Periodical for Self Thinking People. Makes you happy

TRIAL SIX MONTHS, 25 CENTS

C. C. RIESTER, 204 Superior St., Cleveland

COMPOUNDS PROTOPLASM TO PRODUCE ANIMAL LIFE

An Indiana doctor claims to have discovered a chemical compound by which animal life is spontaneously generated. The compound is the nearest approach to protoplasm possible, and when magnified 250 diameters shows minute black particles in rapid motion. The chemist is nourishing the particles to see whether they will propagate a higher culture.

$10.00 BUYS

100 Shares Worth $100 PAR

Full Paid and Non-Assessable

We now own LUBRICATING oil producing property in the finest oil region in the country, some of our holdings being located at Belton, Mo., just 24 miles from Kansas City. Our well is now producing the very finest quality of LUBRICATING OIL. Opportunities like this seldom remain open long. The nominal price of 10 cents per share is offered for a limited time only in blocks of 100 shares and up. The proceeds from the sale of stock are to be used for further developing of other holdings, building converting plants, and the sinking of additional wells, etc. Remember we are producers of LUBRICATING oil, from which we will manufacture by-products, such as oils, axle grease, paints, vaseline, ointments, carriage top dressing, and hundreds of other articles which will bring immense returns on your investment.

Only a limited amount of stock is offered and but for a short time at 10c. per share. Buy now and make money, both on the rise and your dividends, as the stock will soon advance. This is a safe investment and this chance may never come to you again. This company courts the closest investigation. Get our booklet "Oil and Asphalt." It tells all about our holdings.

WRITE TO-DAY, TOMORROW MAY BE TOO LATE

The Company reserves the right to advance the price without notice

Northwestern Consolidated Oil Co.

A. B. 85 DEARBORN STREET, CHICAGO, ILL.

RHEUMATISM

CURED

By Absorption

Summer Heat Opens the Pores, facilitating absorption of impurities through the sweat ducts by MAGIC FOOT DRAFTS

A Dollar's Worth Free

On approval to any sufferer. Write

Summer is the rheumatic's opportunity to cleanse his system of rheumatic poisons. The pores open wide, the blood is active and eager to cast off its impurities, especially through the feet. The largest pores of the body are in the soles of the feet, which are also great nerve and vascular centers, and they are the natural gateway for expelling rheumatism from every part of the body. Magic Foot Drafts, the great discovery for taking advantage of Nature's own plan, draw out and absorb the acid poisons from the blood through these great pores.

They are worn without inconvenience and their record for curing rheumatism, either chronic or acute, no matter in what part of the body, is simply phenomenal. They are so sure to cure that the makers send them free on approval to every sufferer they can hear of. Send in your name. Return mail will bring you a pair of the celebrated Drafts. Try them. If you are satisfied with the benefit received, send us One Dollar. If not, you pay nothing. You decide. Don't delay. Booklet for rheumatics also sent free. Magic Foot Draft Co., 851 Oliver Bldg., Jackson, Mich.

IN THE CZAR'S SERVICE.

The room was dingy and but poorly lighted. Around the long table in its center were gathered the conspirators—the men who had sworn to kill the czar. A strange-looking appearance they made in the flickering candle light; some with fierce faces marked with the bitter lines of hunger and of hate; some with the enthusiastic and wrapt expression of dreamers; others with the cold impassivity of great generals. One of the last mentioned, colder, more impassive than the rest, sat at the foot of the table, facing the president. His manner showed not the slightest nervousness, not the slightest exhilaration. Yet in an hour he meant to betray the men who sat about him to the horrors of a living death on the bleak plains of Siberia, gaining thereby the lasting favor of his imperial master. The blow that would ruin his comrades would make him.

The clock struck 8 as the president rose to speak.

"Brothers," he began, "brothers, we have all sworn the same sacred vows, we have all stood the severe tests of our order—we can all be trusted. It becomes my duty, therefore, to speak out. Our days of plotting are passed; the time for action has come. At last we shall strike a decisive blow for liberty."

He paused, but no one spoke. There was not a sound in the room. Some breathed a little more quickly—that was all. Pointing to a powder keg in a corner, the president continued:

"Our materials are at hand—our opportunity also. The czar visits Krasmoe-Selo on Thursday——"

The noise of the scuffle in the hall outside the door interrupted him. Several of the men who sat about the table sprang to their feet, the door burst open, and an officer followed by a squad of soldiers rushed into the room. In an instant every one of the conspirators was covered by a rifle.

"You are my prisoners!" said the officer curtly.

"By what right?" exclaimed the president. He alone seemed cool; the rest stood as though paralyzed. Ignoring the president, the officer glanced at the others.

"Line up against the wall," he ordered.

Silently they obeyed him—powerless to resist. The officer turned to his men and gave a sharp order. The soldiers raised their guns and aimed them at the defenseless breasts of the prisoners.

Again the president spoke.

"What do you mean to do?" he cried.

"To execute you at once," returned the officer coldly. Then to the soldiers: "Take aim! Fi—"

"Stop!"

The cry rang out loud and clear in the deadly stillness of the room, and the spy sprang forward from where he stood against the wall.

"Stop!" he cried.

"Get back," said the officer sternly; but the spy continued to advance. His coldness, his impassiveness, had disappeared; his face was yellow with fear; his teeth chattered; great drops of sweat stood on his forehead.

"No—no—you must not shoot me!" he shrieked. "I am of yourselves—I am an agent of the third section. It was I who informed against these men. If you kill me it will be murder—murder—murder!" He groveled on the floor at the officer's feet.

The doomed men looked at the miserable wretch with bitter contempt, while in the president's eyes there was something that looked like triumph.

"An agent of the police," said the officer, doubtfully. "You have your credentials?"

"Yes—yes!" screamed the wretch, tearing a piece of paper from his pocket and handing it to the officer. "It is there—it is there. Ah, my God!"

This last exclamation was one of renewed terror, for the soldiers, dropping their rifles, had sprung

(Continued on page 862.)

HOT WATER HEATED for $273

THE *Andrews System* of Hot Water Heating, perfected by 18 years of practical heating experience in Minnesota's vigorous climate, insures a warm house in extremest cold, also low fuel consumption in mild weather. Burns soft coal or hard; is easy to operate and keep in order. Its high grade steel boiler is easily cleaned, durable and constructed upon lines of best engineering practice. Piping and radiation are ample in every respect, making a perfectly balanced job.

The Andrews Mail Order Method gives the purchaser the economy of factory production, all material being completed, the pipe cut ready to be erected by any carpenter or mechanic, avoids all chance of vexatious mistakes by preparing accurate plans and bills of materials, subject to owner's approval before contract is made.

The material is shipped from Minneapolis or Branch in Dunkirk, N. Y., and radiators (70 per cent. of the weight), from nearest distributing point.

$2 Plans for Piping any House

We make estimates FREE. Send your plans or a rough sketch with measurements.

WRITE FOR BOOKLET, "HOME HEATING"

We Sell

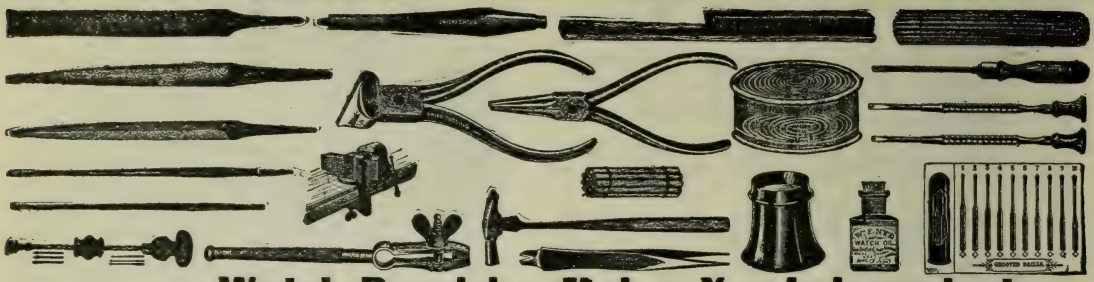
Pipe Fittings, Valves, Tanks, Radiators and Boilers

See our Exhibit at the Manufacturers' Building, World's Fair

215 HENNEPIN AVE., MINNEAPOLIS, MINN.

ANDREWS HEATING CO

Get Into Business On Your Own Account.



Watch Repairing Makes You Independent.

It's a trade easily learned. Our complete illustrated instruction book enables you to perfect yourself for the work at home, giving you every advantage of the apprentice. **Instruction book and complete Outfit of Tools, by express, $5.50.** Large, free catalogs of watches, jewelry and tools, with confidential discounts.

MONEY IN WIRE NOVELTY JEWELRY. Send 10c in stamps for large Wire Artist's Catalogue, with colored illustrations and instructions for making hundreds of patterns of jewelry. Beautiful gold filled sample wire bangle ring free with each book.

ROGERS, THURMAN & CO., Chicago, Ills.

upon him, and were binding him hand and foot.

The president stepped forward with a smile.

"Brothers," said he to the amazed men, who still stood against the wall, "brothers, in a great cause like ours we can not be too careful. This little scene was devised to discover what traitors we had amongst us. It has succeeded. You, who have proved faithful, are quite safe."

The men looked at him as though they could scarcely credit their senses. Then one or two began to sob, and one man laughed.

"And this spy?" he questioned.

A fierce murmur ran 'round the room. The men, with one accord, started toward the corner where the man lay bound.

"Kill him! kill him!" they shouted.

The president raised his hand.

"Stop!" cried he; "the man is mine—mine to punish as I see fit. Leave him to me. You will accompany our brother, Vassoloff," indicating the pseudo officer, "to a place of refuge. From our friend's admission we are no longer safe here."

"But——"

"I have spoken," said the president, sternly.

The conspirators turned and silently went out. As the man who had laughed passed the spy, he kicked him in the face and laughed again.

Then the president was alone with the spy. He stood looking at him for a moment, with a cruel smile on his white-bearded face. Presently he took from his pocket a long fuse, placed one end in the powder keg, and wound the other about one of the tallow candles, an inch from the burning wick. Then he placed the candle in front of the spy's face, where he could almost touch it, and, turning, went to the door. At the threshold he paused.

"Your fate will be a lesson to your fellow spies," he said, and was gone. The spy heard his steps as he went down the passage; he counted them till they died away in the awful silence of the night. Then he looked at the candle. How long would it take an inch of tallow to burn? The police would not come till 9. Would it last till then? He looked at the clock. Twenty minutes past 8. Would that inch of tallow last forty minutes? If it should not, would being blown up be so painful?

He looked at the candle again. It seemed to melt away before his eager gaze. He tried to shriek, but could not. The bruise on his face where the man had kicked him hurt fearfully; he became unconscious. He dreamed of his mother, dead years before. He thought that he was a child again, and that she had taken him on her lap, and was telling him the old stories that he loved. It was summer, and he could hear the reapers singing. He laughed with happiness.

He opened his eyes. The darkness of the room frightened him, and he tried to call his mother. The gag was still in his mouth, and, like a flash, the whole dreadful sickening truth came back to him. The hands of the clock pointed to 8:40, and the candle was more than half burned. He shook like a leaf—a dreadful nausea sickened him.

Again he looked at the clock—8:50. The candle seemed to burn slower. Was there still hope? Would the police come on time—would they come on time? He strained his ears to hear their coming, but there was no sound. Good God! would they be late?

It was 8:55. He tried to pray. He was lost. No! At last he could hear the soldiers approaching; but the clock was striking 9. A knock on the door, and the flame had touched the fuse. He watched the spark as it crept like a snake across the floor, nearer, nearer, nearer to the keg. He tried to scream. The sound of a door being broken open. The footsteps of men on the passage outside the door, but the spark had reached the keg. A flash—

* * * * *

A second later, when the soldiers entered, they saw a sight that frightened even them, used to fearful sights as they were. A dead man, bound and gagged, lay upon the floor, his hair snowy-white and his eyes staring and protruding.

On the floor was the black mark where the fuse had burned, and in one corner was a powder keg—empty!

A story is told of a Pennsylvania farmer who wore his old suit until everyone was tired of it, and his estimable wife was almost ashamed of the hustling man who had been inside it so long. But one day he went to town to sell his produce, and while there he determined to buy a new suit, and, happy thought, surprise Eliza. So he bundled a neat suit into the wagon and drove homeward. It was after night as he hurried homeward, and at a bridge over a river he stood up on the wagon and "peeled" and threw the despised old suit into the water. Then he reached for his new clothes. They were gone—had jolted out of the wagon. The night was cold and his teeth chattered as he hurried home. He surprised Eliza even more than he had anticipated.

ORIGINAL ROOSEVELT CLUB

Roosevelt

Fairbanks

PATENT APPLIED FOR

AND

The only Nose Glass Political Emblem yet originated. Invented by the President of the first Roosevelt Club organized in the U. S. Endorsed and recommended by the National Republican Committee.

Retails 25 cents. Discount by dozen or gross. The emblem is not only for young folks, but it is strictly high class and appropriate for ladies' and gentlemen's use. We want agents at once. Any hustler can make 100 per cent. easily. All you have to do is to wear the emblem—it actually sells itself.

Sample 25 cents. Five different styles will be sent on receipt of $1.00.

CHICAGO COMMERCIAL & SPECIALTY CO., Dept. A, 528 W. 63d Street, CHICAGO, ILL.

PRUSSIAN GOVERNMENT TO MANUFACTURE SAUSAGES.

Prussian soldiers will soon have the satisfaction of knowing that all the sausage they eat is made of strictly wholesome meat. A big sausage factory is soon to be established by that government at Spandau, a very important fortress near Berlin, reports Southard Parker Warner, consular agent at Gera, Germany. The factory will be in charge of the commissary office of the War Department. The department contemplates establishing other factories in all large cities where large bodies of troops are quartered.

SWEDEN'S GREAT PEAT SUPPLY.

There are 8,648,640 acres of peat moss land in the Province of Norbotten, Sweden, reports American Consul Robert S. S. Bergh, of Gothenburg, Sweden. Besides this there are 1,235,520 acres at Pajala and near the coast, one-fifth of the area being of considerable depth. This, according to the present amount of fuel importation to Sweden, would be enough to supply her for 200 years.

HUGE PICTURE OF EMPRESS.

The portrait of the Empress of China, now on exhibition at the St. Louis Exposition, is a bulky affair. With the pedestal on which it is to stand it occupied nearly one-half the space in the car to which it was transferred from the liner Siberia, which brought it to this country. The picture packed weighs five tons.

In California they built a pipe line 280 miles long for conveying oil from the Kern River district to San Francisco Bay. The oil is so thick that it took five days for it to travel the first thirty-seven miles, and the job as planned has been abandoned for other arrangements.

More than 1,035 questions and answers contained in Spangenberg's Steam and Electrical Engineering, published by Geo. A. Zeller, St. Louis, Mo., thoroughly exhaust the subject and make it an invaluable work for mechanics.

THE GREAT AMERICAN TEA COMPANY

We are selling the BEST NEW CROP

50c TEAS

in the U. S.

Oolong, Eng. Breakfast, Gunpowder, Souchong, Congou, Mixed, Japan, Young Hyson, Imperial, Ceylon.

Good Oolongs, Mixed and Eng. Breakfast, 25 & 30c a lb.

We are selling the BEST

25c COFFEE

Good Roasted COFFEES, 12, 15, 18 and 20c a lb.

SPECIAL OFFER

ON a SAMPLE ORDER of $5.00 and upwards, of Teas, Coffees, Spices, Extracts and Baking Powder, we will allow you **20 per cent off and pay all express charges,** so that you may thoroughly test the quality of the goods. This is a chance that is seldom offered; it gives all a chance to purchase our goods at **less than cost.**

For full particulars and prompt attention, address

Mr. CARL, Care of

The Great American Tea Company,

31 & 33 Vesey St., P. O. Box 289, New York

IT HELPS BUSINESS

To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs

Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.

174 Wabash Ave., • • Chicago

A CLOSE SHAVE

That is what we are giving to the price on this Razor Strop. It is not a fancy article with nickel-plated fittings, etc., but all the value is put into the leather.

An Honest Strop for an Honest Price. Sent Postpaid, 50c. Sterling Supply Co., 56 Fifth Ave., Chicago, Ill.

YOU CANNOT "MAKE BRICKS WITHOUT STRAW" BUT YOU CAN SECURE ANY OF THESE

High Grade Tools Without Money

The following carefully selected list of tools includes those which every mechanic needs, and which everyone who engages in mechanical work as a recreation will greatly desire to possess. We have selected a well-known brand, the excellence of which for quality and accuracy is beyond criticism. They are all from the celebrated works of the L. S. Starrett Company, manufacturers of fine mechanical tools. Every tool in these lists can be easily earned by securing a small club of new yearly subscribers to Popular Mechanics;

ANY TOOL IN THIS LIST FOR ONE NEW SUBSCRIBER

		Retail Price.
No. 303	4-in. Spring Tempered Rule	$ .45
No. 403	4-in. Beveled Edge Rule	.45
No. 330	4-in. Narrow Hook Rule	.45
No. 391	Spring Tempered Center Gage	.45
No. 450	Folding Pocket Rule in case	.50
No. 135	Nickel Plated Pocket Level	.50

ANY TOOL IN THIS LIST FOR TWO NEW SUBSCRIBERS

No. 303	Spring Tempered Rule, 9-in	1.00
No. 403	Beveled Edge Rule, 9 in	1.00
No. 420	Hook Rule, 6 in	1.00
No. 21	Thin Straight Try Square, 2 in.	1.00
No. 125	Adjustable Caliper Gage, 2½-in	1.00
No. 193	Protractor	1.00
No. 40	Screw Pitch Gage	1.00
No. 172	Thickness Gage	1.00
No. 87	Mercury Plumb Bob	1.00
No. 146	Adjustable Hack Saw Frame and Blade	1.00
No. 104	Speed Indicator	1.00
One Dozen No. 116 Asst. Nail Sets, in case		1.15

ANY TOOL IN THIS LIST FOR THREE NAMES EACH

ANY TOOL IN LIST 1 AND LIST 2, OR,

No. 405	Patent Draftsman's Scale, 12 in	$1.50
No. 380	Steel Straight Edge, 18 in	1.80
No. 11	12-in. Combination Square	2.00
No. 60	6-in. Reliable Try Square	1.25
No. 425	Slide Caliper Rule, 3 in	2.00
No. 15	3-in. Universal Bevel	1.50
No. 6	Screw Pitch Gage	1.50
No. 36 or 37	6-in. Lock Joint Transfer Calipers	1.50
No. 186	Drill and Steel Wire Gage	1.50
No. 132	6-in. Level	1.50

TOOLS IN THIS LIST FOR FIVE NAMES EACH

ANY TOOL IN LIST 2 AND LIST 3, OR

No. 380	24-in. Straight Edge	$2.40
No. 510	Steel Tape in Leather Case, 50 in	4.00
No. 9	12-in. Combination Square Set	4.00
No. 33	Hardened Steel Combination Squares, Drop Forged	3.00
No. 20	4½-in. Hardened Edge Solid Steel Square	3.50
No. 25	4-in. Caliper Square with Adjustable Screw	4.00
No. 66	Locomotive Guide Liner	3.00
No. 57	New Universal Surface Gage, 12 in	3.00
No. 97	12-in. Improved Level for Testing Shafting	2.50
No. 197	12-in. Electrician's Level Non-Magnetic	3.50
No. 163	24-in. Draughtsmen's T. Square	3.50

TOOLS IN THIS LIST FOR TEN NAMES EACH

ANY TOOL IN LIST 1 AND LIST 5, OR,

No. 3	1-in. Micrometer in Case	$6.50
No. 113	1-in. Micrometer in Case	7.50
No. 2	2-in. Micrometer in Case	7.25
No. 124	B. Inside Micrometer	6.25
No. 360	Universal Bevel Protractor	5.75
No. 196	Universal Dial Test Indicator with Tool Post	7.50

Any tool in the Starrett Catalog desired, and not given above, will be given as a premium for a club. ∴ ∴ For particulars address

POPULAR MECHANICS : : Journal Building : : CHICAGO

"Want" and "For Sale" Ads. 2 cents per word, payable in advance. Replies may be sent to a number, care Popular Mechanics, and will be forwarded promptly without extra charge.

AUTOMOBILES.

FOR SALE—Haynes-Apperson 1902 phaeton, 12-h. p.; thoroughly overhauled and now at factory. As good as new. A fair offer accepted. Have bought touring car same make. J. B. Price, Hazleton, Pa.

FOR SALE—Automobile gear, fine shape, equipped with new tires. C. C. Hollenbach, Columbus, O.

TWO-CYLINDER, 10-12-h. p. French automobile engine in good order, for sale. T. H. Ludwig, 80 William St., New York.

FOR SALE—Buffalo runabout, good shape, $250; 14-in. boiler, $30; boiler shells, $8, all drilled with head and seamless shell; set 28x2½x3-in. wheels, $10. Running gear and body and 3-h. p. auto engine. Box 523, Meyersdale, Pa.

FOR SALE—1903 Orient buckboard, $200; has hood and basket; just thoroughly overhauled and painted; new rear tires. H. L. Lang, Staunton, Va.

FOR SALE—All new; never used: Complete steam runabout, $300; complete steam runabout, little used, $275; complete steam surrey, $400; complete steam touring car, $650; engine, 3½x3½ in. (Keim), $75; engine, 4½x4½ in. 15 h. p., $100; boiler shell, 16x16 in. and 356 tubes, $45; boiler and burner, 18x28 in., 850 flues, $75; boiler and burner, 18x32 in., 1,368 flues, $100; running gear for surrey or runabout, $60; body for surrey, $40; body for runabout, $25. E. A. Wright, Canton, Ohio.

$399.00 WILL BUY a steam automobile. Carries four passengers. Just the thing for rural mail route. C. A. Wardle, Oak Park Ill.

CASTINGS FOR BICYCLE ENGINES. 1½ h. p., $7.00; 2 h. p., $12.00; 3½ h. p., $12.00. W. Hoffman Motor Works, 1253 N. Halsted St., Chicago.

FOR SALE—One new $800 Gasoline Runabout, $600. Frank W. Bacon, Omaha, Neb.

FOR SALE—One new $1,000 Gasoline Runabout, $800. Frank W. Bacon, Omaha, Neb.

AUTOMOBILE PARTS at half price. Complete outfits. Bargains to small builders. C. C. Hollenback, Trustee, Columbus, O.

BLACKSMITHS.

Be a Master Mechanic and expert steel worker by using Toy's Treatise on new steels explaining how to work them with 75 new methods for working all difficult jobs. Ten receipts for making your own compounds for welding different kinds of steel solid. Thermite welding fully explained; also two colored tool tempering charts; chart A explains all annealing and hardening. Chart B explains both scientific and plain tempering to a standard. All the above for $1.00. Valuable samples free. W. M. Toy, Sidney, Ohio.

ENGINES

"SHOP NOTES"—Cloth $1, paper covers 50 cents. Popular Mechanics.

MODEL ENGINE and Dynamo Castings. ⅛-h. p. modern high speed brass engine castings $5; ⅛-h. p. dynamo or motor castings with book of drawings and direction for building and all material, wire, etc., $5.80; dynamo castings ⅛ to 1 h. p., engine castings ⅛ to 4 h. p., locomotive castings on a scale of 1 inch to the foot, consisting of 170 iron and brass castings, $29. Enclose stamp. J. Homer Boals, Sallneville, O.

BUSINESS CHANCES.

FOR SALE OR EXCHANGE—$18,000 stock of general merchandise. Cash sales last year, $70,000. Daily cash sales now $250 per day. Will take good Illinois farm. Best of reasons for selling. Address, 765 Popular Mechanics.

FOR SALE—My harness stock, tools, fixtures and Landis machine; invoice about $2,000; cash sales nearly $6,000; will stand close investigation. W. H. Lawson, Newark, Ill.

FOR SALE—One-half interest in blacksmith and wagon shops, repository and tools. All kinds of material for wagons. For particulars apply to Thomas Ball, Fairland, Indian Ter.

JEWELRY, MUSIC AND PHONOGRAPH STORE—A good paying business; established 16 years; one of the best locations in the city; good run of bench work; cheap rent. This is a snap for someone. Reason for selling, interested in other business. Address Wahl-Gaasch Co., 119-S. Illinois St., Indianapolis, Ind., or 304 Main St., Lafayette, Ind.

FOR SALE—Complete machine shop outfit cheap. Boiler, engine, lathes, shaper, shafting, blacksmithing and other tools. Buxtons, Penn Yan, N. Y.

FOR SALE.

FOR SALE—4-h. p. Marine gasoline engine with access, $85; 5-h. p. auto engine with access, $80; 4-in. bore cylinder, $6 each. Also complete sets of castings. A. J. Houle, 580 East St., Holyoke, Mass.

FOR SALE—Second-hand dynamo engines, telegraph outfits, telegraph teacher, storage batteries and meters. All in good condition. John L. Peacock, 182 W. Fair St., Atlanta, Ga.

FOR SALE—50-h. p. gas engine. If interested, address Hoosier Sweat Collar & Mfg. Co., Indianapolis, Ind.

FOR SALE—One 6-h. p. upright, center crank Climax steam engine. Newkirk Steam Laundry, Newkirk, Okla. Ter.

WESTINGHOUSE DYNAMO, 60 light, second hand; ½ h. p. automatic engine, new; set ratchet pipe stocks and dies, ¾ in. to 2 in., and small set ¼ in. to 1 in., $5. Some electricians' tools and supplies. Pipe taps 1 to 2 in., $2.40. Electrical Books, five vol., new, $3. J. Homer Boals, Salineville, O.

FOR SALE OR EXCHANGE—100 American Machinist and Recreation. Box 65, Manor, Pa.

20-IN. BAND SAW, foot power and power; four saws and in fine order, for $30, or will exchange for a power drill press; Barns former with 13 cutter and saw for $15. Enclose stamp. Salineville Model & Machine Works, Drawer 5, Salineville, O.

FOR SALE—CHEAP—Complete instruction papers, International Correspondence Schools, in Mechanical Drawing. Must sell at once for cash. With or without instruction from schools. "Nemo," care of Popular Mechanics.

RIFLE FOR SALE—New 30-40 Winchester box-magazine, Lymon front and rear receiver sights, carved stock. With 100 cartridges. Cost $34; take $20 cash or exchange. Address A. D. C., Popular Mechanics.

GAS BALLOONS bought, sold, made; any size. Carl E. Myers, Supt. Aeronautical Dept., St. Louis, Mo., Exposition. Address with stamp. Balloon Farm, Frankfort, N. Y.

Five years subscription for three dollars. Popular Mechanics Co. make this offer. A great many people are taking advantage of it. It's open to you also.

FARM PROPERTY.

FOR SALE—Illinois farm; 323 acres; black rich bottom land; clay subsoil; all can be plowed; no better corn land in the state; good buildings; fenced and crossed with Page woven wire; rural free delivery; long distance telephone; good gravel roads to city of 2,500 population. Home market for all farm products. Borden's Condensed Milk Factory. The price paid for milk for past six months, $4.50 per 100 lbs. Good school and creamery one-half mile from farm—6 miles northwest of Chicago. If sold quick will take $80 per acre. Part cash. Address 766 Popular Mechanics.

HELP WANTED.

ONE MECHANIC in every shop to earn good money. Address 'Money," care Popular Mechanics.

WE ARE PREPARED to make yearly contract on salary with experienced lubricating oil salesmen. Our goods on market over twenty-five years. Can also use on attractive commission basis few travelers without previous experience in this line. The Tropical Oil Co., Cleveland, O.

DRAFTSMAN WANTED—We want a first-class draftsman in every city. Write us for particulars. Can make it to your interest to do work for us. Popular Mechanics Patent Bureau.

WANTED—At once, two or three good cornice makers. Apply Henry Weyand Co., Inc., Waterbury, Conn.

WANTED—Boys and girls over 13 years old. Exclusive agency in each town for the wonderful keyless lock. Agents making $3 to $7 weekly working only after school; sample 25c. 100 per cent profit. Write for particulars. Keyless Lock Co., 634 W. 79th St., Chicago.

SUMMER HOMES.

WISCONSIN SUMMER HOME—On the shores of beautiful Green Bay. An artistic 10-room log lodge. Has not its equal this side of the Adirondacks. Accommodations for twelve or more. Huge fireplace, waterworks, large porch and living rooms, kitchen, dining and bed rooms. Unsurpassed for ladies and children. Safe bathing, boating and fishing. Completely furnished (except bedding) to move right into. Any one desiring a summer home will find it perfect. Very reasonable; cash or trade. Address A. D. G., Popular Mechanics.

SPECIALTY MANUFACTURING.

THE NATIONAL SHEET METAL WORKS is especially equipped to manufacture small articles stamped, pressed, cut from sheet metal. White metal casting and plating a specialty. The National Sheet Metal Co., Peru, Ill.

WANTED—If you have anything in light-metal manufacturing, job or experimental work, write me for lowest prices, Geo. W. Dickey, 1103 Osgood St., Chicago.

POSITIONS WANTED.

WANTED—A position for a draftsman, with surveyor or engineer. Good on maps, profiles and that class of work. C. P. Crafts, Tuscola, Ill.

SITUATION WANTED—As manager or superintendent of an up-to-date furniture factory by a man with 28 years' experience and strictly up-to-date; 19 years with best factories in the north. Strictly sober and can furnish best of references. Address Box 32, Ruck, Texas.

YOUNG MAN, studying correspondence course, wants situation as apprentice in drafting room so as to acquire experience in mechanical drawing. Address Box 810, Popular Mechanics.

POSITION WANTED—As motor car operator; 12 years' experience in machine shops; have worked for the Napier Motor Car Co., London, England; can furnish A1 references; English, age 30, unmarried. Address C. Schulz, 316 Valentine St., Kenosha, Wis.

PATENTS

PATENTS SECURED through Popular Mechanics Patent Bureau promptly. Charges reasonable. If you have a new idea or invention write us regarding it. We will answer promptly and fully without charge. Address Popular Mechanics Patent Bureau.

WANTED.

WANTED—Young men to learn Telegraphy and R. R. Accounting. Our graduates receive from $50 to $150 per month. Endorsed by all railroads. Write for catalogue. Morse School of Telegraphy, Cincinnati, O., Elmira, N. Y., La Crosse, Wis., Atlanta, Ga.

MISCELLANEOUS.

BRAINS FOR SALE—Do you want a prospectus written and illustrated for your new company or syndicate? Do you want one that will command attention and sell shares? Do you need a catalogue or booklet that will not be thrown in the waste basket? If so write to Expert, care of Popular Machanics, Journal building, Chicago.

WHEN YOU WANT anything and don't know where to get it, write Popular Mechanics.

THE FRACTOMETER will instantly solve all problems in addition or subtraction of fractions and their decimal equivalents. Every person has need for this wonderful invention, especially Draftsmen, Engineers and Mechanics. Price 50c postpaid, or given free with a year's subscription to Popular Mechanics at $1 per year. Popular Mechanics, Journal Bldg., Chicago, Ill.

BINDERS—Will hold Popular Mechanics 12 issues. Sent postpaid on receipt of 50 cents. Address Popular Mechanics.

FOR SALE OR TRADE—Instruction papers International Correspondence School in Electrical and Steam Engineering. C. E. C., care Popular Mechanics.

IF YOU WISH to buy anything or have something manufactured and don't know where to get it, write Popular Mechanics, Journal Bldg., Chicago.

DEATH is said to be pleasant when it takes place by drowning; however, we do not believe you want to die that way. "How to Swim" is the book that will teach you how to swim. Contains 100 illustrations; sent postpaid for $1. Popular Mechanics.

DRAFTSMEN—"A Chapter on Pulleys," 25 cents. The Draftsman, Cleveland, Ohio.

SCHOLARSHIP—For sale in International Correspondence Schools of Scranton. Pa. Owing to sickness am unable to use same and will sell cheap. Address, A. C., Popular Mechanics.

CONSUMPTION CURED BY ELECTRICITY.

By means of electricity Dr. Canu of Rouen, France, has effected the cure of several cases of consumption which were apparently hopeless, reports U. S. Consul Haynes of Rouen, who witnessed the treatment given to a patient.

The case was one given up by the doctors two months before, who said he could not live 10 days longer. He was first placed upon the operating table, where the usual saline solutions were injected. Afterwards he was seated upon an insulated table and electricity passed through him for some minutes by attaching the poles to metallic plates which had been fastened to his breast and back. During this time sparks could be drawn from any part of his body. This finished, the patient inserted the small end of a conical-shaped tube in his mouth. Into this tube was put a little broom previously dipped into the necessary medicaments for the healing of the lungs or whatever organism was attainted, and through it, the man's body, and an X-ray globe in the rear went the electric current, carrying with it the medicinal "ions" from the broom.

The patient was gaining in strength, weight and appetite, and the doctor further gave authentic addresses of those who had been cured by him.

PHOTOGRAPHY.

Picture Making for Pleasure and Profit, by T. S. Baldwin. This is the very latest and best book on Photography for the amateur and professional photographer, 280 pages, numberless illustrations, cloth, price $1.25. Given for 3 subscriptions.

Photography Self-Taught, Amateur's Edition, by T. S. Baldwin, 140 pages, illustrated, price, paper cover, 25 cents; cloth cover, 50 cents. Cloth covered given for 1 subscription.

PLUMBING.

American Sanitary Plumbing, by J. J. Lawler, a complete practical work, fully illustrated, price $2.25. Given for 4 subscriptions.

Hot Water Heating, Steam and Gas Fitting, by J. J. Lawler, 320 pages, fully illustrated, cloth, price $2.00. Given for 4 subscriptions.

ENGINEERING.

Swingle's 20th Century Handbook for Engineers and Electricians, latest and best popular treatise published, also the best for the young or old engineer, about 500 pages, with over 200 illustrations, full leather pocketbook style, price $2.50. Given for 4 subscriptions.

Farm Engines and How to Run Them, or the Young Engineer's Guide, by James H. Stephenson, 75 illustrations, 223 pages, cloth, price $1.00. Given for 2 subscriptions.

Modern Air Brake Practice, Its Use and Abuse, with questions and answers for trainmen, engineers, firemen, conductors, electric motormen and mechanics, by Frank H. Dukesmith, 250 pages, fully illustrated, cloth, price $1.50. Given for 3 subscriptions.

Practical Gas and Gasoline Engineer, by E. W. Longanecker, the best on the subject, cloth, price $1.00. Given for 2 subscriptions.

Locomotive Up-to-Date, the greatest accumulation of new and practical matter ever published, by Chas. McShane, 736 pages, 380 illustrations, price $2.50. Given for 6 subscriptions.

REFERENCE.

Bookkeeping Self-Taught, by Philip C. Goodwin, the most up-to-date system published, 12 mo., cloth, price $1.00. Given for 2 subscriptions.

Parliamentary Procedure, or Rules of Order for Clubs, Societies, Fraternal Orders, Political Gatherings, etc., by Orson B. Felt, 208 pages, cloth, price 50 cents. Given for 1 subscription. Full leather, price 75 cents. Given for 2 subscriptions.

Webster's System of Memorizing Easy and Difficult Words, a dictionary for the home and school, edited by W. T. C. Hyde, 16 mo., cloth, 336 pages, price $1.00. Given for 2 subscriptions.

Business Letter Writing and Book of Social Forms, by Chas. W. Brown, A. M., 16 mo., 208 pages, paper covers, price 25 cents; cloth, price 50 cents. Given for 1 subscription.

North's Book of Love Letters, with directions how to write and use them, 160 pages, price, paper cover, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Standard Perfection Poultry Book, by C. C. Shoemaker, the recognized standard work on poultry, 200 pages, 80 illustrations, price, paper cover, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Practical Etiquette or Society Guide, a modern book on politeness, by Josephine Stafford, 160 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Complete Debater's Manual, with arguments, both affirmative and negative, by C. W. Brown, A. M., 160 pages, price, paper covers, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Book of Toasts and After-Dinner Speeches, by William Young Stafford, invaluable to both old and young, male and female, 180 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Zancig's New Complete Palmistry, by Prof. and Mme. Zancig. This book gives the most simple instructions in the art, 200 pages, 86 fine illustrations, paper cover, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Guide to Successful Auctioneering, or How to Become an Auctioneer, by Chas. Johnson, 140 pages, paper covers, 75 cents; cloth cover, price $1.00. Given for 2 subscriptions.

AMUSEMENTS.

New Century American Speaker, adapted from the Cumnock School of Oratory, 452 pages, over 100 illustrations, the most complete speaker published, cloth, price $1.25. Given for 3 subscriptions.

Modern Magician's Handbook, by William J. Hilliar. The most complete encyclopedia of magic yet compiled. With this book you can learn how to perform every known trick of to-day; 500 pages, 400 illustrations, cloth, price only $1.50. Given for 4 subscriptions.

Comic Recitations and Readings, a new volume of funny recitations and readings, by Charles Walter Brown, A. M., 200 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Patriotic Recitations and Readings, by Josephine Stafford, containing selections for Decoration Day, Fourth of July, Washington and Lincoln's Birthdays, Arbor Day, Labor Day and other occasions, 200 pages, price, paper covers, 25 cents; cloth cover, price 50 cents Given for 1 subscription.

Little Folks' Speaker and Entertainer, by Chas. W. Brown, A. M., containing cuts and catchy pieces for small children of 10 years and younger, 128 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Little Folks' Dialogues and Dramas, by Chas. W. Brown, A. M., a collection of dialogues and dramas by various authors for little people from three to twelve years old, 180 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Choice Dialect, Monologues and Vaudeville Stage Jokes, as recited by Weber & Fields, Kendall, Thatcher, Rogers Bros., and others, 200 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Dutch Dialect and German Monologues, as told by our leading German comedians, 130 pages, price, paper cover, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Irish Wit and Humor, told by our foremost Irish comedians, 160 pages, price, paper covers, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Conundrums and Riddles, by John Ray. This is the largest and best collection of conundrums and riddles ever published. 160 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Negro Ministrels, Stump Speeches and Black-face Monologues, by Jack Haverly, a complete guide for amateurs for presenting a minstrel performance, 150 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Modern Quadrille Call Book and complete dancing master, by Prof. A. C. Wirth, 160 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Chas. K. Harris' Complete Songster, containing latest songs, 200 pages, paper covers, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Standard Drill and Marching Book, by Edwin Ellis, containing an endless variety of new original drills and marches with music for young people, 160 pages, 30 illustrations, paper cover, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

The Gypsy Witch Dream Book, containing alphabetical list of dreams on every subject, 210 pages, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Because I Love You, the book of love, courtship and marriage for young and old, 200 pages, price, paper cover, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Card Tricks and How to Do Them, by Prof. A. Rotenberg. This book gives with careful and easy instructions the newest card tricks and sleight-of-hand yet offered to the amateur. 170 pages, 80 illustrations, price with paper cover 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Tricks with Coins, by T. Nelson Downs. This book explains how to do every known trick with coins. 170 pages, 95 illustrations, paper covers, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

How to Tell Fortunes by Cards, by Mme. Zancig, fully illustrated, 150 pages, paper cover, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Gypsy Witch Fortune Telling Cards, by Mme. Le Normand, containing 53 fine enamel cards for telling your past, present and future. Can also be used in playing any card game. Price, per pack, 50 cents. Given for 1 subscription.

Hermann's Book of Magic and Black Art exposed and explained, 180 pages, 41 illustrations, price paper covers, 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

---- ACETYLENE SEARCHLIGHT ----

FOR YOUR YACHT

A neat, compact, self-generating, portable Searchlight of high power for power and sailing yachts. A necessity and ornament to every yacht. Useful in locating buoys, making landings, detecting obstructions, etc. Should be part of every yacht's equipment.

WRITE TODAY FOR CATALOG

AMERICAN ACETYLENE STOVE CO., 506 Masonic Temple, Minneapolis, Minn.

CRANE VALVES

ESTABLISHED 1855

THE WINGET CONCRETE BUILDING BLOCK MACHINE

Automatic Adjustable

Makes any size or shape block required in ordinary building operations

Straight & Corner Block

A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

LOW PLUMBING BILLS

Get them by paying right prices for supplies. We sell

SUPPLIES AT WHOLESALE

You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.

B. P. KAROL,

229 W. Harrison St., Chicago.

TO PURCHASERS OF BABBIT METAL

WE TAKE THE LIBERTY OF DRAWING YOUR ATTENTION TO A HIGH GRADE

BABBIT METAL

which costs you only 8c. per pound, delivered to your factory. This metal is manufactured by a special process that contains all the virtues of the compound fluxes that are so beneficial to metal or alloy. When mixed at the melting time, and poured into the boxes, the compound flux generally is mixed with the metals, moulded in bars, placed on the market, and by the time the consumer prepares this metal to be poured, the beneficial effect of the flux is almost if not entirely destroyed, it being burnt out by the several melts which it has undergone.

This Babbit metal flows freely, leaves bearing surface perfectly smooth, is tough and elastic, and will not shrink away from the box. We shall be pleased to forward to your address or to such place as you desire, such quantity as you may require, to give it a test.

U. S. REDUCTION CO.

84 W. Washington St. Chicago, Illinois

Send POPULAR MECHANICS Just for PREMIUM LIST Out

ANTS TO KILL COTTON BOLL WEEVIL.

The ravages of the cotton boll weevil, amounting to millions of dollars annually to our cotton crop, is to be stopped. The government experts have discovered in South America a species of ant unknown in this country, whose special enemy is the cotton weevil. Already a healthy colony of these ants have been imported and will be turned loose in Texas, to wage war on the weevils. The ant is harmless, having no dangerous bite or sting, as do many varieties of tropical ants.

WASHINGTON, THE WORLD'S MAP CENTER.

Geneva, Switzerland, formerly recognized as the greatest map producing center of the globe, has now surrendered the honor to Washington, D. C. Twelve bureaus of the United States government there are engaged in the work of issuing and printing maps of the finest quality and requiring the highest class of workmanship. This has resulted in attracting to Washington the best cartographers and map engravers in Europe. The maps turned out by the government are of every part of the globe. The great confusion resulting from the different spelling of geographical names in each of the bureaus has been done away with by the creation of a board of geographical names. It is the duty of this board to decide upon the name of places and localities before they go to the map engraver and printer.

"SHOE DOCTORS" REAP A HARVEST.

"Shoe doctors" reap a harvest in large cities, gathering together old cast-off shoes left in retail shoe stores repairing them and selling them to second hand junk dealers. A writer for the Shoe Trade Journal says:

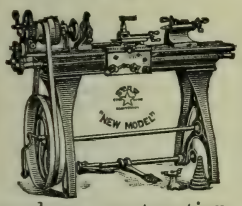
Last week an old man with a bag of old shoes boarded a street car on which I was riding. The shoes were old timers and my curiosity forced me to ask questions. The man said he got the shoes for nothing from retail shoe dealers and repaired them so that they sold for from 75 cents to $1 a pair. He had handled 1,100 pairs of shoes last year and hoped to do better this year. Here is a case of one man preventing the sale of more than a thousand pairs of new shoes by his own efforts, in Chicago alone. If only the poor and needy bought the made-over shoes, one would not feel surprised, but the truth is that many thrifty persons who could well afford better, take advantage of the ingenuity of clever cobblers and pay $1 or less per pair.

NEWSPAPER FOR THE DEAD.

A newspaper containing the record of deaths as they occur, together with remarks suitable to each case, and also the name of the doctor who treated each person is to be published in Paris.

The proof of each item is to be presented to the physician it refers to and if he pays a large enough fee the item will not be published. Such a paper would put the "quacks" out of business.

"STAR" FOOT AND POWER LATHES



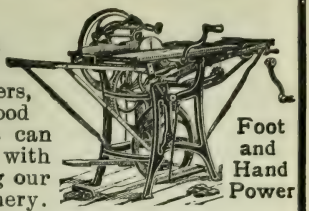
Are used extensively by repair shops, tool-makers, gun-smiths, experimental and model makers, etc.

Built for durable and fine accurate service, containing throughout the highest type of modern construction. 9 to 14 inch Swing.

SEND FOR CATALOG "B."

Wood Working Machinery

COMPLETE OUTFITS



Foot and Hand Power

Carpenters, builders, cabinet-makers, wood workers and others can successfully compete with large shops by using our labor-saving machinery.

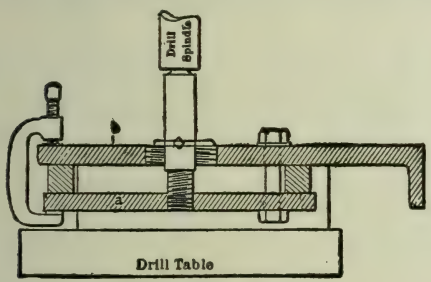
SEND FOR CATALOG "A."

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N.Y., U.S.A. Adv. No. 44.

TAPPING LARGE WORK IN A DRILL PRESS WITHOUT A TAP.

A writer in the American Machinist tells how he mended a broken apron belonging to a large lathe, without a tap and in three days' time. He says: The stripping of the parts, molding, and casting the new apron left but one day to machine it. Two of the large gear studs to be refitted were threaded 10 to the inch, but there being no lathe large enough



A Vertical Lead Screw

to swing the apron, chasing a thread in this manner was out of the question. Accordingly, the tip of the boring bar used for making the holes was turned down to three-quarters inch and threaded ten threads per inch. An ordinary iron strap *a* was tapped to match and clamped just below the apron *b* to be threaded as shown in the accompanying sketch, the strap acting as a leader for a thread-cutting tool which was inserted in the boring bar.

ARRESTED BY TELEPHONE.

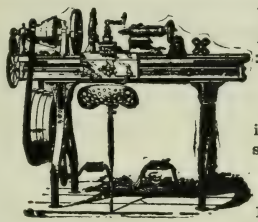
Automobiles are getting pretty fast these days, but the telephone is quicker. A little girl was crossing one of the crowded streets of Cleveland when she was run down by a careless driver. Firemen at an engine house near which the accident happened tried to catch the fellow, but he drove rapidly away. One of the firemen hurried to a telephone and called up a police station toward which the man was driving. He gave a description of the man and told the police to be on the lookout. In a few moments the offender was under arrest.

WHILE - THEY - LAST

8, 9, 10 and 12 HACK SAW BLADES

30c. Per Doz. $3 Per Gross

SAMUEL HARRIS & CO., 23-25 S. Clinton St., Chicago



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

FOOT and POWER

AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

AUTOMATIC —PIPE— WRENCH

Strongest
Simplest
Best

It is self-adjusting and self-releasing. It never gains. Made in three sizes, 10-inch, $2.00; 16-inch, $2.75; 24-inch, $5.00, express prepaid.

H. P. VAN NESS
607 Northern Office Bldg., CHICAGO, ILL.

TYPEWRITERS ALL MAKES

All the Standard Machines Sold or Rented Anywhere at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g Typewriter Emporium, 196 La Salle St., Chicago

J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing
165-167 Dearborn St. Chicago

NAME PLATES, TRADE MARKS

THE MEYERCORD CO.
DECALCOMANIA TRANSFERS
NAME PLATES, TRADE MARKS AND ORNAMENTS
OPALESCENT TRANSFER WINDOW SIGNS
CHAMBER OF COMMERCE BLDG. CHICAGO

TRANSFER WINDOW SIGNS

INVENTIONS PERFECTED through designing working drawings, and superintended by **MECHANICAL EXPERT** of wide reputation and practical experience.
GEORGE WEISS, Mechanical Engineer, 614 Omaha Building, CHICAGO, ILLINOIS

Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE

W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

W. X. Stevens
(Estab. 1867)
Solicitor of American and Foreign
PATENTS
Honest advice; honest service. My record—97 per cent. successful cases. Booklet free.
1065 Virginia Ave. -- WASHINGTON. D. C.

MODELS AND SUPPLIES
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Avenue, Chicago

PATENTS
Protect Your Ideas
Consultation Free
Fee Dependent on Success
Established 1864
MILO B. STEVENS & CO.
885 14th St.
Washington, D. C.
Chicago Office,
163 Randolph Street

WHAT IS A PATENT?

In an address before the Lewis Institute, Samuel G. McMeen said:

"This bargain is to the effect that because the inventor furnishes to the people a more or less useful product of his brain they in their turn guarantee to pay him for his effort. The payment is not made in a definite sum of money, but is an arrangement whereby he may enjoy for seventeen years all the profits coming from the use of the thing he has produced. Rights to these profits he may sell or rent to others or make such disposition as he likes; but from the time of the making of the bargain the thing belongs to the people. At the end of the seventeen years the inventor has no further claim on his production, and it belongs thereafter wholly to the people, having been bought and paid for.

"In a sense, the price paid by the people is set by the inventor. It may be very large or very small, depending on the excellence of the invention or on the caprice of the people. Examples will come to mind of inventions almost trivial, so far as real usefulness is concerned, but which give the inventor large financial returns. There are other examples of inventions which were epoch-making, but because they were too soon for the minds of the people, brought no financial return. It may be that if they had been invented later, so that the period of monopoly had coincided with the period of welcome, the reward might have been proportionate to the excellence of the conception.

"The industrial greatness of this nation is in large measure due to the existence of good patent law and to the encouragement which has been given to inventors by its operation. The inventive ability of a people lies not alone in its facility in finding ingenious ways of setting things together to achieve results, but also in its wisdom to see clearly industrial and social needs. In the instance of the inventor who produced the cranberry sorter, every one in the cranberry industry knew the need of sorting so that cranberries for market would contain no soft ones. It required a mental aptitude to see an immediate possibility of invention in the circumstance that when cranberries were spilled down the back steps only the sound ones hopped from step to step, the soft ones stopping early.

"It is not true that a patent granted by the United States may be renewed. A reissue is not an arrangement by which an expiring patent may be given new life, but only an arrangement whereby a necessary correction may be accomplished. In other countries there are periods of patent life which, by proper action, may be extended somewhat as in the case of a copyright in this country; but in each case there is an ultimate time beyond which the term of the patent can not be extended.

"An applicant may not secure a patent in this country if his invention has been in actual public use for two years or more before he makes his application. Interesting questions sometimes arise as to whether the use has been really public or might not have been wholly for the purpose of testing the efficiency of the invention by a continued test. A form of sidewalk which had been in use for two years was held not to vitiate the rights of the applicant because, although distinctly in public use, the excellence of its form could only be proven to the

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building - - WASHINGTON, D. C.

inventor by actual trial, and could not be considered to be a final test unless continued for a considerable time. In another instance of an article of wearing apparel distinctly not public in its use, a period of two years was held wholly to vitiate the rights of the applicant because very much less than two years should have sufficed to enable him to decide whether the invention was or was not in a proper form for filing his application."

HANGING MORE HUMANE THAN ELECTROCUTION.

Several recent cases of electrocution have stirred grave doubts in the minds of many who formerly believed this to be the most humane method of execution. Now the question as to whether hanging, which, when properly managed, means instantaneous death, is not the best way after all, is being discussed, and those states that have adopted electrocution, unless steps to make it an infallible means of quick and painless death are soon taken, may go back to hanging.

One New York criminal recently was electrocuted three times before death resulted, and after the second attempt, had been taken from the chair before it was perceived that he still lived. In another case the sufferings of the victim were most horrible, and reminded men of the dark days of the rack and the thumbscrew.

HOW TO OVERCOME A DOG.

With the exercising of a little science and trickery a small man can easily protect himself from the assaults of the fiercest of dogs and generally come out victorious without receiving any punishment. Here is the method of defense as is contained in the Rev. Dr. Newman Hall's autobiography:

"Take off your hat and hold it in front of you. The dog will at once bite the rim. Then kick violently under your hat, and the distance being exactly that of your leg, the toe of your boot will strike the lower jaw of the dog, who will at once go off in great pain."

The plan was given to Dr. Hall by a farmer. The very next day he was crossing a field, when a fierce dog ran at him. There was no refuge near. He had no stick. He remembered his lesson. In an instant the dog rushed howling round the field, and the grand old dissenter with a very slight wound in his hat went his way.

MECHANICS NEED IT.

In renewing his subscription to Popular Mechanics, L. H. Chapman of Okeene, Okla., says: "I do not see how any one who is a mechanic or an overseer or foreman of a number of workmen can do without it."

SPECIAL MANUFACTURING

Dies and Stamping

--TO ORDER--

SPECIAL MACHINERY, MODELS EXPERIMENTAL WORK

DROP FORGING DIES AND DROP FORGINGS

Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.

THE GLOBE MACHINE & STAMPING CO.

973 Hamilton St., - Cleveland, Ohio

Send for
POPULAR MECHANICS
PREMIUM LIST.
Just Out

Geo. J. Munroe

ATTORNEY AT LAW and FINANCIAL AGENT.

Companies Incorporated and financed in any State or Territory at Reasonable Rates.

Write for Particulars.

SUITES 1011, 1012 and 1013 Hartford Bldg., 140 Dearborn St., CHICAGO

Mention "Popular Mechanics" when writing.

SAVE MONEY

By sending to us for Blue Prints and Drawings, Model, Die and Pattern Work. Experimental Machines built to order. Write for Estimates.

FOTO MFG. CO.

General Contractors, 58 Fifth Avenue, Chicago

MODELS

CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES

ESTABLISHED 1867

PIN A DOLLAR BILL TO COUPON -- FILL OUT -- SEND TO US

POPULAR MECHANICS CO., Journal Bldg., Chicago:

Send your magazine one year to the following address, commencing with the_____issue

NAME .....

STREET .....

CITY..... STATE.....

Please mention Popular Mechanics when writing advertisers.

The Open Court

AN ILLUSTRATED MONTHLY MAGAZINE

Devoted to the Science of Religion, The Religion of Science and the Extension of the Religious Parliament Idea.

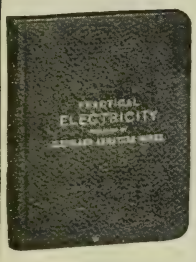
10 cents per copy - - - - - - $1.00 per year

SCIENCE is slowly but surely transforming the world. Science is knowledge verified; it is Truth proved; and Truth will always conquer in the end. The power of Science is irresistible. Science is the still small voice; it is not profane, it is sacred; it is not human, it is superhuman; Science is a divine revelation.

Convinced of the religious significance of Science, *The Open Court* believes that there is a holiness in scientific truth which is not as yet recognized in its full significance either by scientists or religious leaders. The scientific spirit, if it but be a genuine devotion to Truth, contains a remedy for many ills; it leads the way of conservative progress and comes not to destroy but to fulfil.

The Open Court on the one hand is devoted to the *Science of Religion;* it investigates the religious problems in the domain of philosophy, psychology, and history; and on the other hand advocates the *Religion of Science*. It believes that Science can work out a reform within the Churches that will preserve of religion all that is true, and good, and wholesome. Sample copies of *The Open Court* sent on request together with illustrated catalogue of important publications for the Study of Religion. Published by

THE OPEN COURT PUBLISHING COMPANY, 326 Dearborn St., Chicago.



A School Within Itself

Space will not permit our telling you all about this book, but better still, we give you a chance to examine it for yourself by our offer to refund money if book is not satisfactory upon examination. Under this offer, 11,000 copies have been sold and paid for, and out of this number we have refunded for only fifteen copies. There are nineteen chapters, carrying you from the fundamental principles of electricity through the art to the finished dynamo. Contains a dictionary defining 1,500 words.

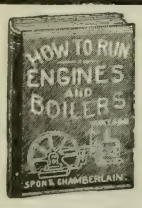
3rd Edition. Price, $2.00 delivered.

CLEVELAND ARMATURE WORKS, Cleveland, Ohio

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly.

$2.00 a Year

WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.



7,000 COPIES SOLD

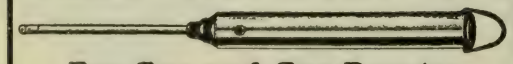
THE BEST BOOK to HELP YOU MAKE MORE WAGES

Written in plain language and fully illustrated.

Spon & Chamberlain FREE for $1.00

Dept. P. M. Liberty Bldg., New York

ELECTRIC LIGHTER



For Gas and Gas Ranges

A perfect, safe, economical lighter. Saves its cost in matches

No Household Should be Without One

The only really successful lighter on the market.

PRICE, DELIVERED IN CHICAGO, $1.25

To any part of the U. S. or Canada, Shipment Prepaid, $1.50. AGENTS WANTED. Address

MODEL ELECTRIC CO.

Dept. A, 85 5th Ave., Chicago, Ill.

THE SEVEN LIES OF MAN

Behold the seven lies of man
And tell his age by that;
As soon as he can lisp he says:
"It must have been the cat!"

Next, when the baseball team begins
To make its thrilling score,
His well beloved grandmamma falls dead
A dozen times or more.

Third, like a furnace does he sigh;
Of course we know the gist;
He tells the maiden fair she is
The first he ever kissed.

Fourth age, he comes home in the morn
And gladness fills his cup—
The good Samaritan has been
With sick friend sitting up.

Fifth, to the woodshed he repairs
His heir to interview,
And says: "My son—kerswat! Kerswish!—
This hurts me more than you!"

He next has leisure on his hands
And fills a jug with bait;
He hooks a minnow, then he swears
Ten pounds to be its weight.

Last age, when lean and slippered grown
He finds his greatest joy
In telling what perfection ruled
The days he was a boy.

—New York Sun.

RATS MADE OF OAKUM—A SEA YARN

An amusing yarn is current in Sydney maritime circles. It is to the effect that the captain of a well-known Australian clipper, the "Caduceus," wishing to clear his ship of rats, offered his crew a glass of grog for every rodent killed or captured. The result was speedily apparent in the diminished number of rats, yet, somehow or other, there were always a few, the crew, anxious for supplies of grog, having devised a means of manufacturing them out of oakum. The captain's curiosity was aroused one day by noticing a supposed rodent floating very "light" on the port quarter. He waited his chance, and when the next man appeared with a rat, the captain remarked, "Throw it to windward." The result was dead against the sailor, for the oakum rodent was blown back on to the poop. Thenceforth there were no more rats and no more extra grog.

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

LEARN LAW AT HOME

We can teach you by mail. 14 years experience enables us to say this positively. Our thousands of graduates prove it. Plan endorsed by lawyers and educators. Three courses: College, Preparatory and Business law. Liberal terms. Special offer now. Catalog free.

THE SPRAGUE CORRESPONDENCE SCHOOL OF LAW,
872 Majestic Building, Detroit, Mich.

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,
127 NASSAU ST. ROCKFORD, ILL., U. S. A

POPULAR MECHANICS

SHOP NOTES

∴ 128 PAGES ∴
204 ILLUSTRATIONS

\- - -

Easy Ways TO DO Hard Things

\- - -

Bound in Cloth - - $1.00
Paper Covers - - - - .50

SENT POSTPAID ON RECEIPT OF PRICE

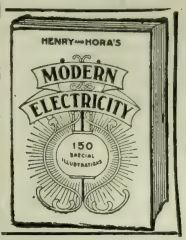
POPULAR MECHANICS
Journal Building Chicago, Illinois

MARRY WEALTH, BEAUTY. Marriage Directory FREE. Pay when married. Entirely new plan. Send no money for particulars.
SELECT CLUB, DEPT. 448, TEKONSHA, MICH.

Greatest Electrical Book

HENRY & HORA'S

Modern Electricity



A new and complete encyclopedia of this great science. Full descriptions of all electrical devices and machines, systems of transmission and distribution—every important branch of electrical science, including X-rays, wireless telegraphy, radium, etc. Devoid of theories and technical phrases. Complete cross index and appendix, 355 pages.

THE PROBLEMS OF ELECTRICITY SOLVED

An invaluable aid to the electrical engineer, workman, apprentice or student.

PRACTICAL : ACCURATE : SCIENTIFIC

Absolutely original matter prepared by expert electrical engineers, never published before.

150 ILLUSTRATIONS
drawn especially for this work.

Silk Cloth Decorative Cover, Silver Stamping, : : : $1.00
Seal Leather, Marbled Edges, Gold Stamping, : : : : 1.50

Laird & Lee's Imprint on Scientific and Mechanical Books Guarantees Reliability.

AT YOUR DEALER'S OR
SENT POSTPAID ON RECEIPT OF PRICE.

LAIRD & LEE, PUBLISHERS, 263-5 Wabash Av. **CHICAGO**

SOMETHING NEW

A book giving dimensions of

Pipe Fittings and Valves

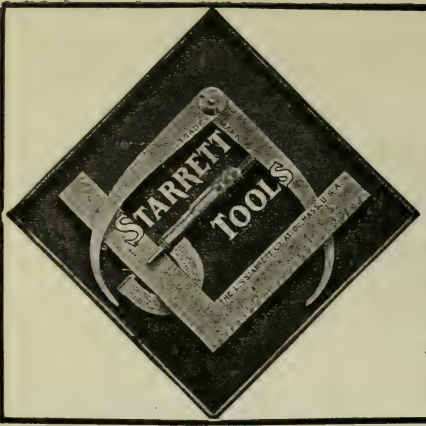
Over 50 tables and many illustrations of all kinds of articles that the draftsmen and architects may need in laying out pipe work on drawings.

Flexible Backs. Good Paper. Postpaid, 50c

ADDRESS

THE DRAFTSMAN
Cleveland, Ohio

WE PAY CASH for Newspaper Clippings. Names and Addresses Write, enclosing stamp for particulars. **The E. M. SMITH COMPANY, 114 E. 23d St., N. Y. City.**



VALUABLE INFORMATION FOR

Expert and Amateur Machinists

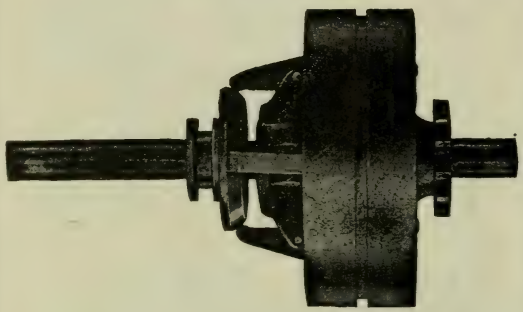
WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

Successors to THE P. J. DASEY CO.

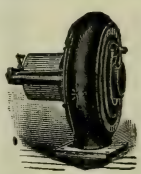
1339 Michigan Blvd. Chicago, Ill., U. S. A.

AUTOMOBILE PARTS

OF EVERY DESCRIPTION.

Write for Catalog and Prices.

OTTO KONIGSLOW,
CLEVELAND, OHIO



for circulars.

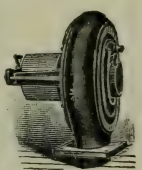
WATER MOTORS

¾ to 15 H. P.

for Ice Cream Freezers, Coffee Mills, Churns, Printing Offices and small Electric Light Plants, etc.

Electric Motors and Generators, Combination Water Generator for charging storage batteries. Send stamp

C. S. PIPER & CO.,



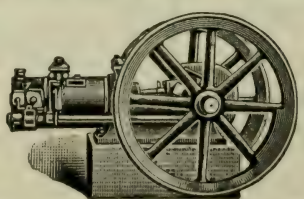
Detroit, Mich.

CRANE FITTINGS

ESTABLISHED 1855

OUR EXHIBIT at the St. Louis World's Fair

consisting of **17** Gas and Gasoline Engines, **11** of which are piped up and running, is the largest, most comprehensive and most attractive display in this line ever made.



Our friends will find at the space good drinking water, electric fans, comfortable chairs and writing materials. Visit us, see our exhibit and test our hospitality.

The OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street MINNEAPOLIS: 318 3rd Street OMAHA: 1108 Farnum St.

GREATEST IRRIGATION RESERVOIR IN THE WORLD.

Arid Arizona is soon to have a vast water storage. For some time the government has been actively employed in the construction of a great dam at Tonto Basin, some 80 miles northeast of Phoenix, Arizona. This is among the first work commenced under the act of Congress appropriating $15,000,000 for the reclamation of arid western lands.

The famous Tonto dam will represent the greatest water storage enterprise in the world, as it will produce the largest artificial body of water ever known in the history of the world. Notwithstanding the Nile reservoir covers a large area, it is only a few yards deep; while the Tonto reservoir will, in places, be over 200 feet in depth.

After months of investigation on the part of the government surveyors Tonto was selected as the best point along Satt river for the construction of the stupendous dam. The flow of Satt river is so variable that the stream cannot be depended upon to irrigate the vast tracts of sterile soil without water-storage.

While the government is advancing the money for the building of this colossal dam, it will ultimately be repaid by the land owners. Already nearly $1,000,000 has been expended in preliminary work, and it is estimated that an additional $2,000,000 will be required to complete the work.

The storage of water will keep pace with the construction, so that the great benefit the government is bestowing will be realized at once.

This Tonto reservoir will extend 18 miles up Satt River and 12 miles up the Tonto, and on an average will be four miles wide. It will drain an area of 6,000 square miles of mountains mainly covered with dense forests.

The dam site is 600 yards below the mouth of the outlet cañon at the junction of the two streams. The dam is being built with a crown pointed up stream. It will be 270 feet high, and 225 feet wide at the base—tapering upward to a 16-foot roadway at the top, over which will pass a United States mail highway.

At the dam site the cañon is only 200 feet wide at the base of the dam and 400 feet at its top.

The dam is being built of rocks weighing up to 12 tons, laid in Portland mortar, and water-tight. The bedrock strata tips up stream, thus rendering sliding impossible; while the dam will be on so massive a scale that it will become a veritable part of the towering mountains surrounding the reservoir site. It will be able to resist any pressure the elements could ever bring against it.

What is ultimately to become the bed of this reservoir, is now studded with beautiful ranches, the rights of which have already been purchased.

The preliminary work of this enterprise is on a great scale. It includes saw mills, an electric plant, a cement mill, a power canal 15 miles long, the opening of 100 miles of difficult mountain roads, telephone lines, piping water three miles for domestic purposes, a cable-car line, derricks, blacksmith shops and many other minor industries.

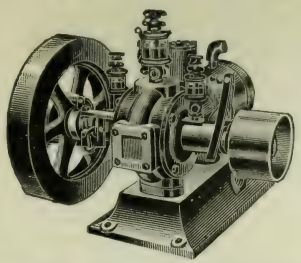
A large stone quarry has been opened and immense quantities of lime and brick are being burned. All material for making first-class Portland cement has been found within seven miles of the dam site.

The line of work extends for 85 miles from a point 42 miles east of Phoenix to the saw mill in the heart of the Sierra Anchas. Camps have been established all along this line, and the domestic and culinary problems are scarcely second in difficulty to those of the engineer and mechanic.

A great army of men, teams and machinery will soon be engaged and the "commissary supplies" will be similar to those in conducting a war campaign.

Many months will be required to complete the work. The benefits, in an agricultural way, to accrue to that part of parched and arid Arizona by this stupendous water-storage will be immense.

SMALL GASOLINE ENGINES

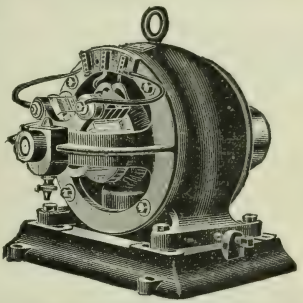


Latest
Simplest
Cheapest
Best

Our new type 1 h. p. gasoline engine has no equal; suitable for all purposes where light power is desired. Starts instantly and runs until you stop it. Has automatic governor; runs at varied speeds.

MAKE YOUR OWN ELECTRIC LIGHT.

For residences and small individual isolated plants. Finest electric light cheaper than kerosene. No combination lighting outfit such as we offer, has ever before been placed on the market. Price within the reach of all. Send for full descriptive circulars.



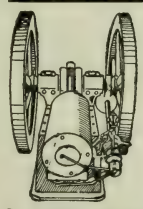
Martin Mfg. Co.,
180 W. Madison St.,
CHICAGO

THERMO-PILES

1½ Volts 1½ Amperes

For Electrolytic Analysis, Charging Storage Batteries, Driving Small Motors, Etc. No chemicals, no smell. **$3.00 EACH.**

WALSH'S SONS & CO., 261 Washington St., Newark, N.J.



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY
25 West Randolph Street, Chicago

SPROCKETS

and EQUALIZING GEARS

IN STOCK OR TO ORDER.

Standard makes of Chain on hand.
Prompt delivery.....Catalogue free.

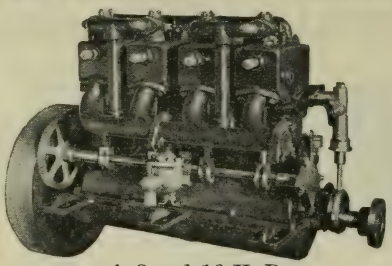
CULLMAN WHEEL CO., 522 Larrabee St., Chicago

Peerless Electric Co.

ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET

141-143 South Clinton Street
'Phone Main 1025 Chicago

AUTOMOBILE AND MARINE MOTORS

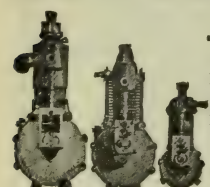


4, 8 and 16 H. P.
Simple, Compact and Powerful. Best material, perfect workmanship. Send for prices.
ALEXANDER & CROUCH, 71 W. Monroe St., Chicago

BICYCLE MOTOR CASTINGS

for Bicycle, Automobile, Marine or Stationary. Also finished Motors and attachable outfits for bicycles. Send 2 cent stamp for catalogue.
STEFFEY MFG. CO.
Brown and Pennock Sts., Philadelphia, Pa.

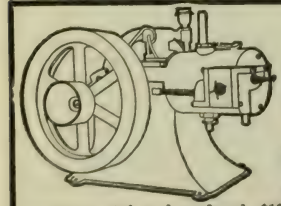
SUPPLIES
DIRT CHEAP
Write for Catalogue and Green Discount
THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago



1 3-4 H. P. Bike Motor $7.50
Castings with Drawings 1904 Model
Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. Send for circular to
EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

GAS and GASOLINE ENGINES
...1 H. P. to 125 H. P...
DYNAMOS & MOTORS
⅛ to 400 H. P.
Complete Lighting or Power Plants for individual uses, large or small, including Engine, Dynamo and Switchboard. Tell us your requirements.
THOMSON CO., 309 Dearborn St., Chicago

KEROSENE OIL ENGINE
Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago



1-4 H. P.
Gas Engine
Castings for $15
with blue prints. Cylinder bored out and faced off.
Runs by gas or gasoline, Water Jacketed. 1-2 H. P. castings, not bored or faced, $16.00. Send for catalog of engines, dynamos, electrical supplies.
L. W. GILLESPIE & CO., 228 E. 4th Street, MARION, IND.

THE PROFESSOR'S BLUNDER

John W. Mackay was an early riser, a hard worker and, although exceedingly hospitable, was himself abstemious and could seldom be induced to play cards for money, and then for only nominal stakes. The game he liked most was one by which the mining superintendents on the Comstock beguiled a portion of the noon hour while waiting for luncheon at the Savage Co. hoisting house. Boys caught grasshoppers and sold them to the players at 25 to 50 cents each. Each player paid a fixed stake, ranging from $1 to $20, into the pool, and the man whose hopper made the longest jump captured the pool. One day before Christmas it was agreed to celebrate that holiday with a pool, the stakes in which were to be $1.00 for each player. The terms were "play or pay," and at the instance of a German professor, who was a superintendent of a leading mine, each man was allowed to use any means that he might devise to stimulate his grasshopper. The professor was so full of his scheme to scientifically capture the $1,000 pool—for there were 10 entries—that he communicated it to a young assayer who was not a grasshopper plunger. The professor had experimented and ascertained that a grasshopper that was touched by a feather dipped in a weak solution of aqua ammonia would jump for his life. The young man also experimented, and as a result he filled a bottle of the same size and appearance with cyanide of potassium and managed to substitute it for the other in the professor's laboratory. The next day, when the professor, after much boasting about his scientific attainments, dipped a feather in the substituted bottle and touched his insect with it, the grasshopper rolled over as dead as a salt mackerel, amidst the roars of the crowd. Mackay's hopper won the big pool, and two widows, whose husbands had been killed in the Yellow Jacket Mine, received a gift of $500 each from an unknown source.

ABOUT THE SIZE OF IT.

It's almighty queer, but the fact is quite clear
That most of the people today
Who get in the papers, cut up some wild capers,
And get advertised in that way;
While the people who do what is honest and true,
As a rule never get any praise,
But the fellow who's tough, finds it easy enough
To rush into print nowadays.

Would there be any hint of a story to print
If a man kissed his wife at the door?
But if he should kiss some alluring young miss,
Dear, dear! how the papers would roar!
It's queer that the man who is straight never can
Get credit for honors well won,
While the rascals and crooks fill the papers and books
With stories of what they have done.

If a trusted cashier remains year after year
In the bank, where he's toiling away,
Without stealing the cash, does he cut any gash
In the news columns day after day?
But oh, how they'll spout if the fellow skips out
With all of the greenbacks and gold!
While his whole pedigree in the papers we see,
Where the story is spicily told.

Don't look to the press or its columns to bless
The good deeds men constantly do;
Such items they choose to turn down as "no news,"
They want something "spicy" and "new."
When a story you see that is unmercifully
"Scareheaded," you don't have to look
Very far through the stuff till you know well enough
That it deals with a rascal or crook.

—Sunset Magazine.

Chemistry SPELLS Economy

CHEMISTRY has become a necessity not only to the manufacturer, but also to everyone directly or otherwise interested in manufacturing industries. There is no branch of human endeavor in which a chemist cannot help you. We can analyze and tell you how to duplicate and save money in the manufacture of any preparation on the market. Tell us your troubles and we will help you.

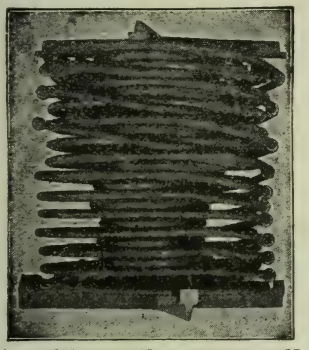
We have the best equipped laboratories in Chicago for general chemical work.

The analysis of lubricating oils, fuel, boilers, compounds, etc., is a specialty of ours.

THE ELLSWORTH LABORATORIES, **357 Dearborn Street, Chicago**

Our New **FLASH BOILER**

For 1904



No burning of boiler—No water gas—No smoke
Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

Condensers, and other appliances are marvels of mechanical development.

Barton Boiler Company

SOLE MANUFACTURERS,

4230 State St., Chicago, Ill., U. S. A.

Write for full particulars

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

POPULAR MECHANICS CO.

MACHINERY BARGAINS

SEND FOR MY PRINTED PRICE LIST OF

Automatic and Slide Valve Engines, Hoisting Engines, Boilers, Heaters, Air Compressors, Rock Drills, Crushers, Locomotives, Steam Shovels, Pile Drivers, Dump Cars, Dredge Machines, Traveling Derricks, Cableways, Concrete Mixers, Coal Mine Hoists and Machinery Generally. I handle both New and Second-hand.

WILLIS SHAW, - - - - 171 La Salle St., CHICAGO

ELECTRIC FAN

PRICE COMPLETE $6.00

Diameter 9 inches, run by dry cell battery; weight of fan and battery only 15 lbs. Can be carried and set up anywhere; always ready to start. Invaluable in the sick room, at the dining table, or on the office desk.

Send for FREE catalogue of other Electric Fans, Dynamos, Gas Engines and all Electrical Supplies.

L. W. GILLESPIE & CO.,

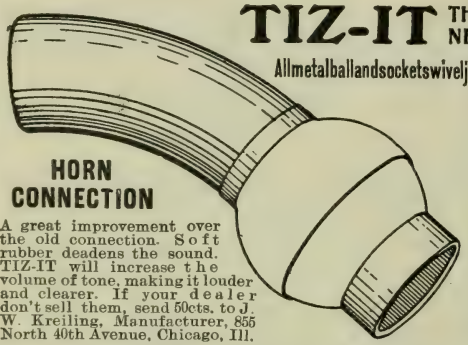
229 E. 4th St. • Marion, Ind.

A Phonograph Improvement!

For Reproducing and Recording.

TIZ-IT THE NEW

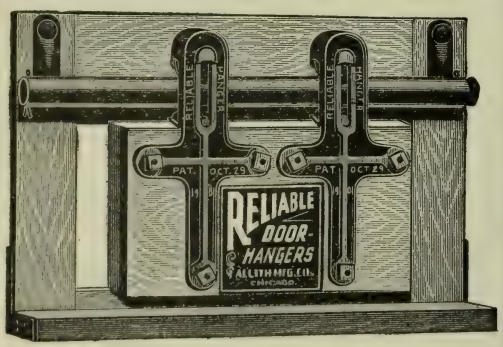
All metal ball and socket swivel joint



HORN CONNECTION

A great improvement over the old connection. Soft rubber deadens the sound. TIZ-IT will increase the volume of tone, making it louder and clearer. If your dealer don't sell them, send 50cts. to J. W. Kreiling, Manufacturer, 855 North 40th Avenue, Chicago, Ill.

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks

Ours Will Not Bind

Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.

120 South Green Street, Chicago

DOBBIN'S DESPAIR.

I have no differential clutch
And no pneumatic tire;
I guess I don't amount to much,
For none come to admire
My form or speed—I have no cam;
And, to my deep remorse,
I must confess I only am
A one-horsepower horse!

They used to stroke my sorrel side
And tell how I could go;
Today they speak in tones of pride
Of some bright red tonneau.
But, though my sorrow is so great
And anger is so keen,
I'm glad to have a chance to state
I don't eat gasoline.

I don't know how to carburet,
Now how to radiate—
When I wished to get up and get
I simply struck my gait.
'Tis true, in casting out the beam
For fairness I should try—
But 'lectric, gasoline or steam,
The "mote" is in my eye!

I have no wondrous steering gear—
But still they rush to see
A thing that has, I'm pained to hear,
A horseless pedigree.
They used to pet me all the time,
But now they only shrug
Their shoulders, and pass by, for I'm
A poor old sparkless plug!

ELECTRICAL ORE FINDERS.

The several inventions for locating veins and bodies of ore by means of electrical instruments have been looked upon with more or less doubt. A recent demonstration in England, before a number of electrical experts, including several scientists of note, determines the fact that some of these instruments are capable of very reliable work, while not able to perform miracles. Dr. Thompson said: "It is quite certain that where there are well defined lines of ore underground, they can be localized by means of the apparatus." He had been skeptical, but is now convinced of its utility in locating such bodies as galena and other conducting ores, but was not so sure in the case of gold mining.

ROTHSCHILD'S "SUCCESS RECIPES."

The following twelve maxims form part of the will of Mayer Anselim Rothschild, the founder of the great banking house at Frankfort. They are going the rounds in Europe and America:

1. Seriously ponder over and thoroughly examine any project to which you intend to give your attention.
2. Reflect a long time, then decide promptly.
3. Go ahead.
4. Endure annoyances patiently and fight bravely against obstacles.
5. Consider honor as a sacred duty.
6. Never lie about a business affair.
7. Pay your debts promptly.
8. Learn how to sacrifice money when necessary.
9. Do not trust too much to luck.
10. Spend your time profitably.
11. Do not pretend to be more important than you really are.
12. Never become discouraged, work zealously and you will surely succeed.

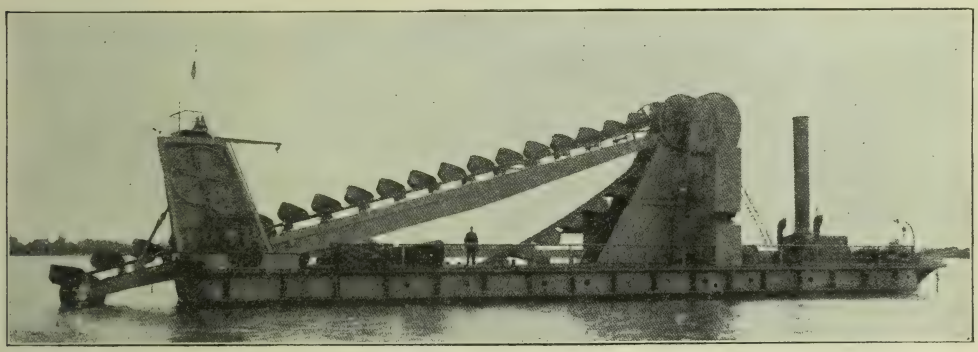
Popular Mechanics

Vol. 6. No. 9. CHICAGO, SEPTEMBER, 1904. 10 Cents a copy. $1.00 a year.

Powerful English Dredger Lifts Over a Thousand Tons an Hour

An English railway company now has in operation a huge dredger, the "Marquess," which has a maximum capacity of 1,030 tons of dredged and discharged material per hour. The entire hull of this powerful machine is of mild steel. Its deck is 136 feet, 3 inches long; 24 feet, 7½ inches wide and 10 feet deep. The bucket ladder is 88½ feet long and each bucket has a capacity of 19 cubic feet. The buckets pass over the upper tumbler which is 28 feet above the load water line, at the rate of 16 a minute. By means of a valve they empty into either of the discharge chutes which are located on either side. The transmission of power is by two camel's hair belts, and if the buckets meet with an obstruction the belt slips and prevents the chain breaking. The engine is of the compound type, fitted with a surface condenser and a reverse.

The boiler is of the type used on sea vessels. The dredger is provided with five steam and two hand windlasses and all its operations are controlled from the deck. It is lighted by electricity throughout and has cabins for the captain, mate, engineer, fireman and crew. It operates to a depth of 45 feet below the surface of the water. The contract on which it was constructed called for a capacity of 650 tons per hour for work in compact clay, gravel and sand and 325 tons per hour for work in marl. It far exceeds this as its average is 853 tons per hour.

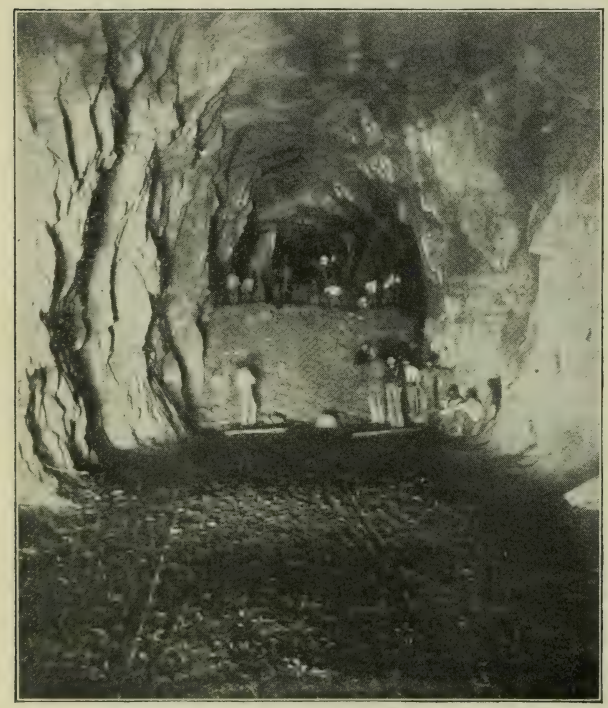


The "Marquess," a Huge English Dredger, Excavates 1,030 Tons of Material Per Hour

SANTA SUSANA TUNNEL FINISHED.

Third Largest Tunnel West of the Rocky Mountains

The great Santa Susana tunnel is finished. For over three years hundreds of men have toiled ceaselessly by night and day boring the long hole through the Santa Susana mountains. The tunnel which is 8,000 feet long saves six miles of mountain climbing for the main transcontinental line of the Southern Pacific railway. It cost over



"For Three Years Men Toiled Ceaselessly."

$1,000,000 and is the third largest tunnel west of the Rocky mountains.

The tunnel is about 35 miles northwest of Los Angeles, and was begun in 1900. The work was prosecuted from both sides of the mountain, and at each opening was established camps to accommodate the workmen. Electric light and air compressing plants were installed in each camp. The drilling and hauling away of the debris was done by machinery driven by compressed air. The escape of air from the drills furnished fresh air for the men engaged in the work. So complete were all the arrangements that few accidents occurred during the entire work.

When the two working forces met there was less than a foot difference in their lines. Trains are now running through the big bore and the workmen and their machines have gone elsewhere, and the two villages which were their homes for three years are deserted.

DON'T LOSE YOUR HEAD.

One of the most important and valuable traits is the ability to retain your presence of mind at all times. We say all times, because there is little occasion to use any effort to keep cool when affairs are as they usually are or should be, but in emergencies, the times when the man with self-possession is not carried off his feet in the mad rush of the panic. And it is a quality which anyone can attain if he only will. The young man, especially, should train himself to this at every opportunity. When once he begins to realize this power, this self control, he will progress rapidly.

What training will do is easily illustrated in the case of the horses in fire departments, which stand alone in their place with a shower of sparks falling all about them, or the cavalry horse, who never flinches while his rider rests a rifle on his head and fires. If horses can be so trained, certainly our young men should not be less qualified. It is quite as essential as a knowledge of swimming.

Take for instance the Slocum disaster. It now appears that had one man kept his head, it would not have occurred. The fire started in a barrel of rubbish, and one of the deck hands tried to smother the flames by throwing a sack of charcoal over the barrel. Then he rushed to another part of the boat in search of a hose; before he returned the fire was beyond control. What he could and should have done, as shown at the coroner's investigation, was to throw the barrel overboard and the danger would have been removed. Systematic and regular fire-drill would have aided the man's wits when the emergency came, but this he had not had.

It is a desirable quality to be brave, but mere courage will never accomplish the results which belong to the man who does not lose his head.

Trolley Line to Run Through the Capitol Building at Washington

Congressmen and Senators Will All Ride Free

An electric trolley line will be built through the great Capitol building at Washington. It will not pass up the big front steps, nor through the Senate chamber, but will go whizzing through the basement far below, and Senators and Congressmen can ride free to the heart's content. Anything free is understood to appeal with great force to the average politician, and there was no trouble in securing the necessary right of way through the building and under some of the principal streets. The main depot will be under the Capitol building and several swift elevators will convey the passengers from the different floors of the building down to the central station.

Capitol Building Where Main Depot will be Located, and Street Under Which the "Congressional Limited" will Run

The line is to be a standard electric street car system running in subways to the splendid new office buildings, one of which will be erected for the exclusive use of Representatives and another for the Senators. Already the street car line is spoken of as the "Congressional Limited." The track will be laid in a handsome subway many feet below the street. The walls will be of soft tinted, light colored glazed brick and the arrangements for lighting, heating and ventilation will be perfect. The congressional throat and lungs are not to be subjected to any danger from cold and pneumonia.

The passenger cars will be open, resembling those on scenic railways, but much more comfortable and luxuriously appointed. There will also be broad, smooth cement walks extending along the track for those who prefer to walk. The distance from the Capitol to either of the office buildings is not great, and the cars will make the trip in from two to three minutes.

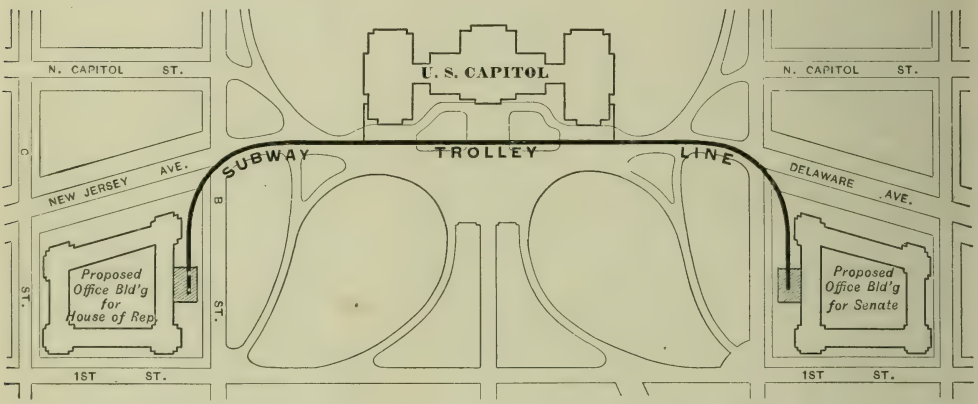
When the Congressman, in his office, hears the Capitol roll-call buzzers, an electric elevator will take him down to his "train" in the basement; a quick dash

through the tunnel, and then another elevator takes him up to the Senate or House Hall, as the case may require.

A freight service will also be installed to run on the underground system, for the purpose of carrying Congressional speeches and other heavy and voluminous printed matter and supplies.

An enormous electric power plant is also a part of the subway line construction. This plant, which will be one of the most perfect ever built, will cost $700,000 and will be located south of the new office building for Representatives. It will furnish power to the railway and all the electric elevators in the office and Capitol buildings, as well as light for them all, and will also run hundreds of electric fans and ventilators. Wires will also be carried underground to the Congressional Library building. The present electric plant is of considerable size, having an output of 2,200 horsepower, with a lighting capacity of 25,000 16-candlepower incandescent lamps, and is located in the basement of the Capitol. Few visitors ever reach these "lower regions" and few even of the guides have ever visited the place. The other machinery includes the boilers and eight steam pumps for fire service.

The Capitol is a magnificent structure, ideally beautiful; sufficient in itself to inspire to good works. Costly machinery furnishes pure, cool air in warm weather, and hot air in winter. Just why machinery is necessary for this latter feature, the average citizen will scarcely comprehend. Bath rooms, barber shops, restaurants galore, are at hand to strengthen and refresh the lawmaker for the work which is chiefly done by the clerk provided each by a generous government. Not satisfied with all this and $14 a day, the magnificent office buildings will be added at a cost of some millions.



Map Showing Route of the "Congressional Limited" Trolley System

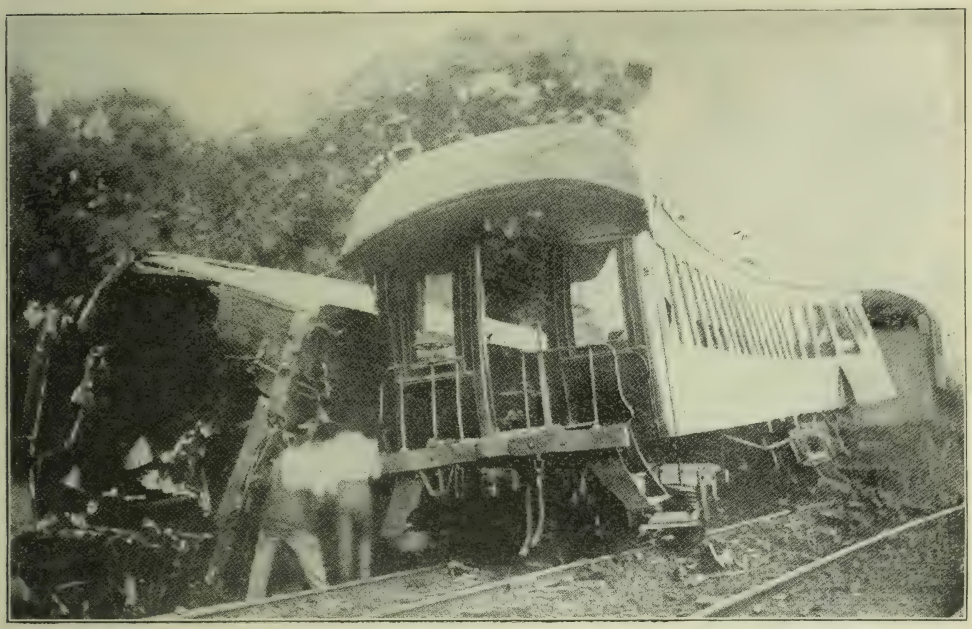
DANGER IN ELECTRIC LAMP DECORATIONS.

It is dangerous to cover incandescent lamp bulbs with drapery and, notably so, to wrap them in cotton, declares Engineering of London. The danger is said to be the greatest in the case of colored lamps. With 16-candlepower colored lamps, cotton in contact with the lamp begins to smoke after ten minutes and sometimes even after three minutes. Only a slight draft of air is required to make the cotton burst into flames, when the bulb collapses on account of its walls softening from the heat. Low candlepower lamps seem to be as bad in this regard as larger lamps. Great care should be taken not to allow inflammable draperies, and particularly those of a fuzzy or fibrous character, to come into contact with the bulbs of decorative lamps.

BIG APPLE CROP THIS YEAR.

A big apple crop is assured this year; not since 1896 have there been so many apples on the trees. Picking and packing time will mean busy days for the orchardists, but before that the box and barrel makers must do their work. Hundreds of thousands of barrels must be made especially for the apple trade.

Passenger Train After Collision



Courtesy Chicago Daily Journal.

The Overturned Coach Where the Victims Met Their Deaths

The above illustration shows part of the wreck of the Sunday School excursion train on the C. & E. I. railroad recently. Twenty-two persons were killed in the overturned car. The passenger train collided with a coal train which occupied the wrong track.

THE AUTO SAVED THE BANK.

As a pleasant change from the many accidents which of late have been credited to the auto comes the story of how one of these machines saved a bank. It was the Lancaster Bank, at Lancaster, O., and the excited depositors were in a panic, each one fighting and pushing to draw out his savings before it was too late. The bank apparently was all right, but the officers had failed to make the people believe it, and a furious run was being made, and rapidly the supply of currency and coin was melting away. Bonds or securities would not go with the angry crowd; nothing would satisfy them but the coin.

The president hastened to Columbus for cash, but reached the depot just too late to catch his train. There was no other train for hours. The money would do no good unless it were behind the railing in the little bank 40 miles away. It was a time for quick action. The president secured an automobile and loading his $35,000 into it ordered the operator to do his best. The roads were none too good, there were hills to climb, and the trip seemed ages to the anxious banker, but in one hour and 28 minutes the machine with its dust-covered passenger dashed into the little town with horn blowing and the banker standing on a seat waving his hat.

The crowd at the bank paused in its scramble, then parted to form a passageway for the clerks who ran out to bring in the heavy bags of coin. Load after load they lugged into the bank while the delighted cashier slashed the bags and piled up the money in great heaps, gold on one side, silver on the other, and stacks of bills built up cob fashion.

When the people saw the display, with the cashier calling to hurry up and get their money, they concluded they didn't want it, and the few who drew out returned in a few hours and put it back again.

And so the auto saved the bank.

Doves of Peace Are Messengers of War

How Japan Has Established an Efficient Pigeon Service in a Short Time

From earliest history the carrier pigeon has played an important part in the fortunes of war and in other troublous times and now, when she has a powerful rival in wireless telegraphy, she still wings her long flight far above the confusion and din of battlefields and carries safely the important messages on which hang mighty issues. What she carries matters nothing to the dove; it is not man to whom she is faithful, but home ties. Her gentle breast knows no other goal—she is speeding homeward. But to the weary, suffering army the safe delivery of the message may mean everything. Even when wireless telegraphy shall have been proven infallible for that purpose and it shall have been demonstrated that outside parties cannot intercept messages not intended for them, the mighty nations of the earth will consider the culture of the best strains of these birds an important item in military affairs.

Russia has long had an established carrier pigeon service and it has been of incalculable aid to her in sending messages from her beseiged fortress, Port Arthur, to her generals in Manchuria. The birds were collected from outside lofts months ago and taken into Port Arthur to be liberated as needed and they have been the surest messengers of all.

Five years ago had this war overtaken Japan she would have been entirely unprepared in this particular; today her pigeon service is the equal of any in the world. With the remarkable care even in minute particulars which has elsewhere distinguished her, her naval officers sought for and purchased the choicest, most reliable strains of birds the English market could afford. These were, of course, kept for stock purposes, for had they been released they would have attempted to return home. They soon became acclimatised and as they are very prolific the Japanese naval and military lofts, extensively established were soon filled with young birds; so young that the lofts to which they had been taken became homes to them to which, amid any and all conditions their strong instinct would henceforth guide them. The birds reared in the Oriental climate soon displayed a swiftness in flight which outdistanced pursuing hawks. The clear, dry air of the country is favorable to them and in some respects they are now superior to their English forebears.

All Japanese war vessels have pigeon lofts and every vessel that leaves port carries a wicker basket containing birds from coast lofts by which messages may be sent to land. In the present war the Japanese were at a disadvantage in that the scene of the war and marches was in a strange land where they had no established lofts. To overcome this they contrived a system of traveling lofts which displays great ingenuity. These traveling lofts contain young pigeons barely old enough to be taken from the home nest and are carried with the army on the move for two months or more. Then the lofts are removed to a temporary post and the birds released. In a short time they become familiar with the country for miles around and the place becomes home to them. After that they may be sent out with scouts to bring back reports of observations. The scout carries as many as six birds in a bamboo cage slung over his back. Oft-times information which these birds bring is sent on by other birds.

The message itself is written on specially prepared rice paper and enclosed in a little celluloid case which does not weigh over 62 grains. This case is fastened by two clips to one of the pigeon's legs, and during flight is held close under the bird's tail. When a bird returns to a Japanese naval loft it enters an outer cage and passes into a long box which opens into the loft. A glass door closes the opening into the loft, however, and the weight of the bird tilts the box so that a shutter falls behind it and it is caged. At the same moment an arrangement of electric bells announces its arrival and these continue ringing until the bird is released. When the message has been removed the bird is allowed to remain in the loft fully as long as it has been away from it.

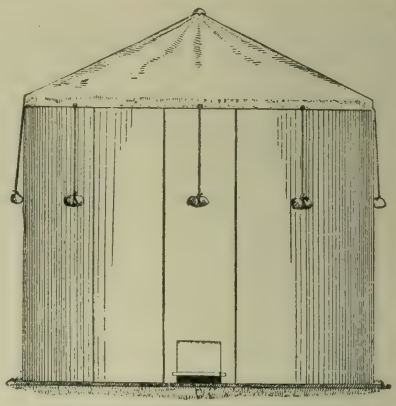
Pigeons are strong enough to fly distances of a hundred miles at the age of three months. Over land their flight is circling, but when liberated at sea they rise to an altitude of 1,400 feet and shape a direct course. An average speed is 50 miles an

CYCLIST SCOUT WITH PIGEON
PIGEON LOFT WITH FIELD FORCE
BASKET for CARRYING PIGEONS
THE WAR PIGEON
SCOUTS LIBERATING BIRDS WITH MESSAGES
OFFICER WRITING MESSAG
MESSAGE HOLDER ATTACHED To PIGEONS LEG
METHOD OF TRAPPING THE BIRDS ON THE BATTLE FIELD

hour, or under very favorable conditions 80 miles an hour. For distances of 300 miles the average rate varies little. They are usually liberated at an early hour as they cannot see to fly well in the dark.

PORTABLE GRAIN BIN.

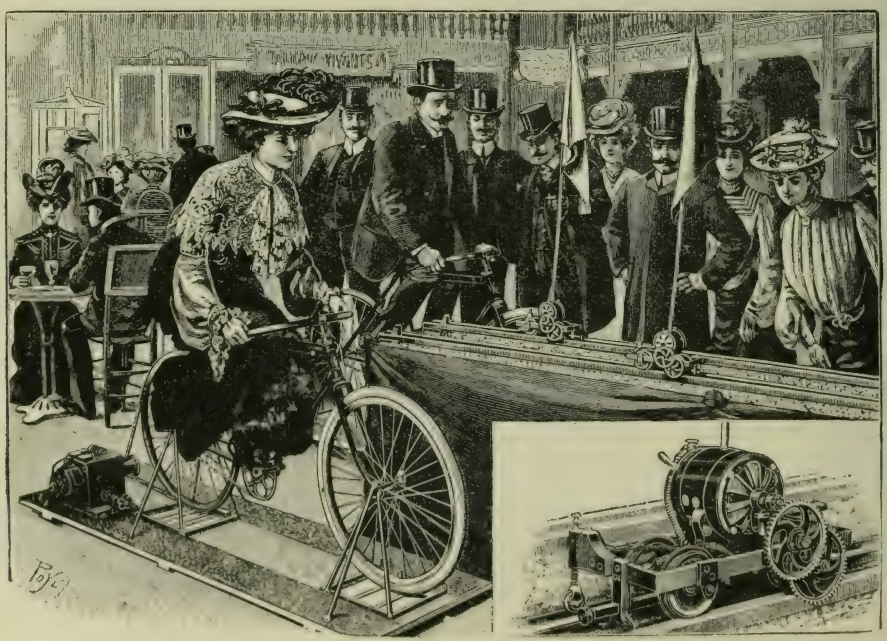
A year ago we published a picture showing a pile of 30,000 bushels of wheat lying on the ground in Oklahoma, with no covering whatever. The elevators were overflowing, and it had been hauled many miles to a railroad. There was nothing to do but dump it alongside the track until cars could be secured. The case mentioned was only one of many. A recent invention growing out of this emergency is illustrated, showing a portable grain bin made to contain 2,000 bushels which can be set up in a short time. The sides are galvanized iron, the floor heavy plank, and the top waterproof canvas.



Portable Grain Elevator

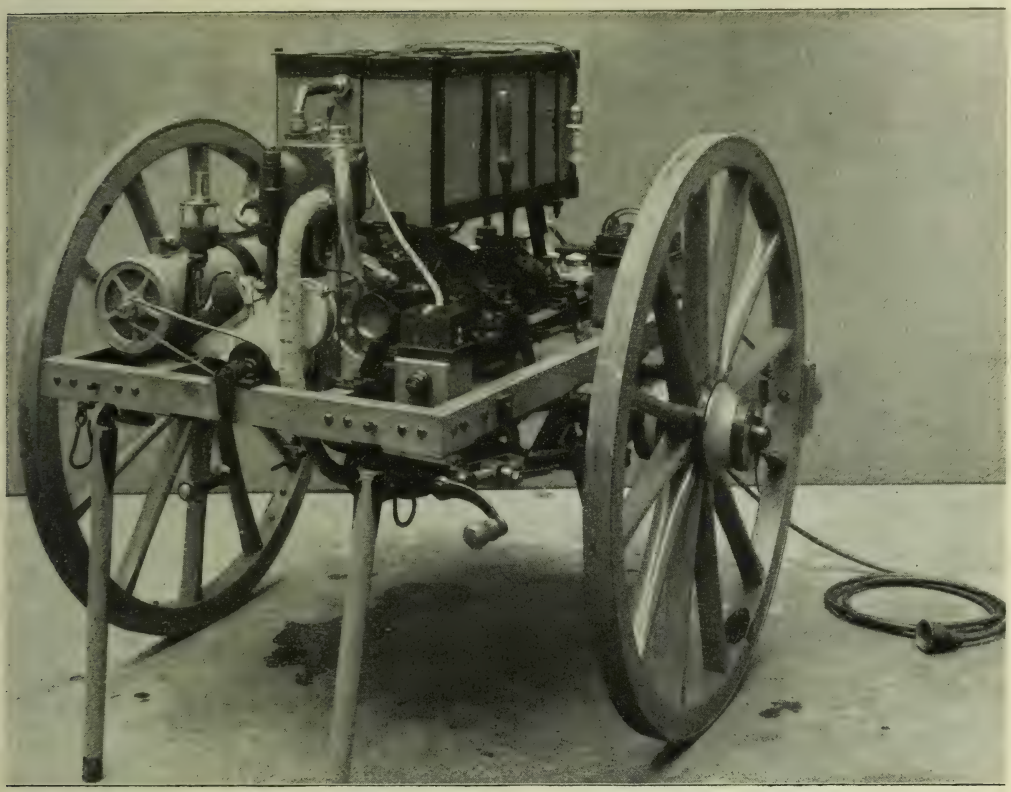
Stationary Bicycle Race

To run a bicycle race without leaving the place where you start is the latest craze in places of amusement in Paris. The illustration shows how it is done. The wheel is fixed in a frame fastened to the floor. When the rider begins to pedal, a belt from the rear wheel drives a small electric generator. The current thus produced is conducted to a motor on wheels and carrying a flag. The track on which the motor travels is marked in distances and each foot of track requires as much work by the rider as would have carried the bicycle one mile had it been free to run as under ordinary conditions of use. In the picture the woman is about two miles ahead.



Stationary Bicycle Race and Recorder

Armies Will Use Portable Space Telegraph Stations



The Portable Power Station

Already tests of wireless telegraphy for military purposes are being carried on by the great military powers of the globe. While the Russo-Japanese war is proving that this use of the great invention is practicable, it also is giving rise to many questions and perplexities and will necessarily entail an endless succession of experiments before the world knows just how much wireless telegraphy is to be relied upon in any crisis.

The Germans are now carrying on interesting experiments with portable space telegraph stations for military purposes. These stations are arranged for a short and a long wave length, the antenna remaining the same in both, but oscillating in the short wave three-quarters of a wave, while in the long one it oscillates one-quarter of a wave. In the short wave the antenna is overbalanced by a counterweight of 65 square feet of copper gauze stretched out about 3¼ feet above the ground, while for the long wave 260 square feet of counterweight are required. Kite balloons about 355 cubic feet in volume, with a pull of about 6⅗ pounds, support the antenna.

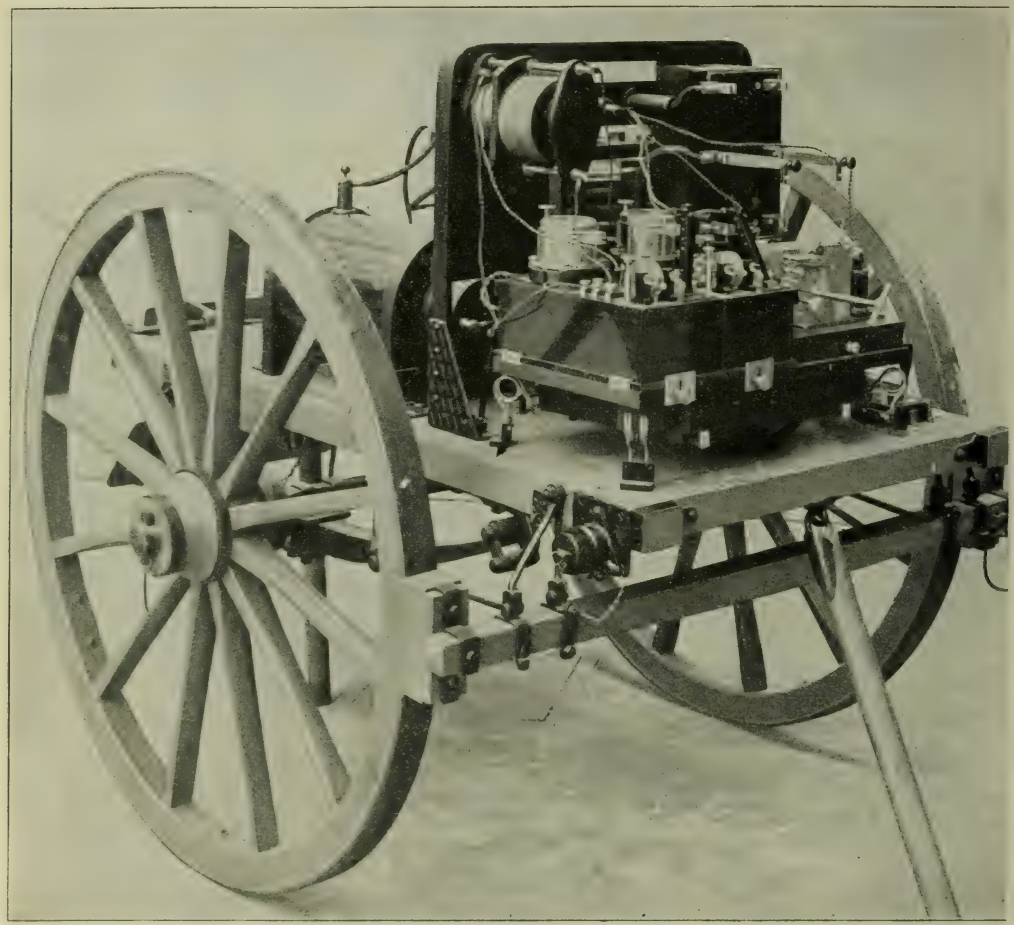
Each station comprises three two-wheel carts. A power cart containing a 4-horsepower gasoline motor direct-coupled to an alternating-current generator of an effective output of about one kilowatt and an exciting machine, which apparatus constitutes the current source. A reservoir located above the machinery contains water for cooling the motor; the water is circulated automatically by a small pump, and a tube system and a ventilator cool the water. Gasoline for operating the motor is carried in another reservoir of about 8 gallons capacity, sufficient for a continuous telegraphic service of 30 hours. The exciting dynamo of the alternator automatically charges the accumulators which operate the

electrical ignition device. The balloon is pulled in by means of a conical friction coupling, which, by a chain transmission, causes a cable drum to rotate.

The apparatus cart carries both the sending and receiving appartus. It is divided by a frame into two compartments, the front one containing the induction coil, a battery of Leyden jars and a high-tension transformer. It is protected from contacts and accessible only through a trap on the side wall. The Morse key occupies the back compartment. Two receiving apparatus and a Morse recorder are on a board supported by strong springs, while on the table of the recorder is located the small transformer. The large transformer, the receiving plug and counterweight switch with two levers are arranged on the frame in the middle of the cart. A side wall carries a telephone and electrolytic detector and the door is provided with an alarm bell.

The balloon, gas reservoir, reserve gasoline reservoir and trenching tools are carried by an utensil car. The gas reservoirs are built into the cart.

With this outfit safe communication up to more than four days' marching is possible, while in the case of an audible record of signals the distance susceptible of being covered may even be double. The portable stations are adaptable to naval use also, and are the same as were used in signaling the progress of automobiles in the Gordon Bennett race of this year.



Apparatus Cart.--Portable Space-Telegraph Station for Military Purposes

A new process converts the fiber of asbestos into a cloth like silk.

AMERICAN TURQUOISE IN EUROPE.

The American traveler who buys turquoise in Italy little realizes the fact that most of it comes from America. He could have bought the same turquoise cheaper in his own country, but the American likes to be "duped." Most of the turquoise sold in this country and in Italy comes from the mines in New Mexico. The American product is gradually but surely displacing the Oriental stone. The colors of the American turquoise are not only more to the taste of the connoisseur, but are more permanent, the fading of a New Mexican turquoise being a very rare occurrence.

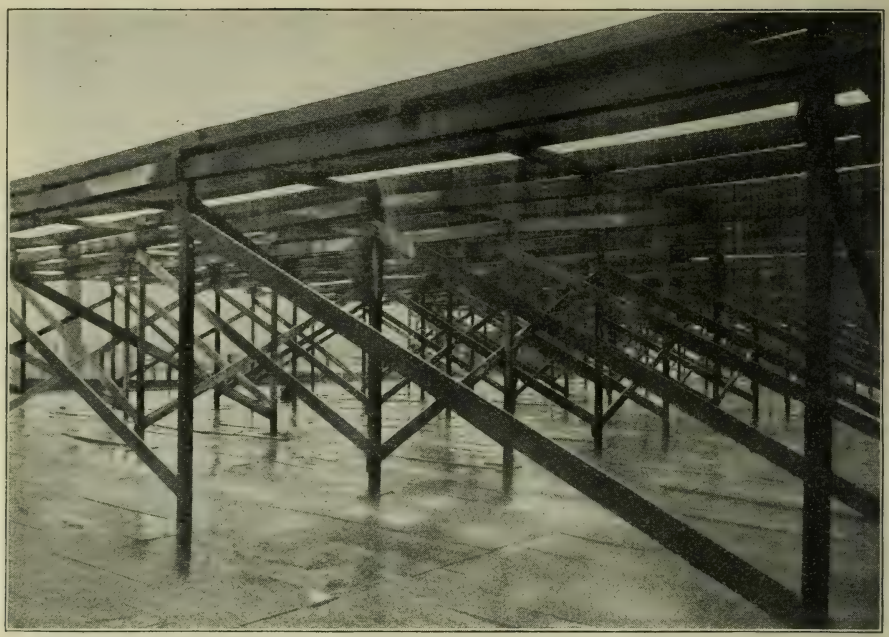
Turquoise mining in New Mexico is of very remote origin. Many of the present mines when located indicated operations by the inhabitants of New Mexico at a time prior to or contemporaneous with the Aztecs, stone and earthen vessels of great antiquity being found in the workings. The rarest specimens of the wampums of the New Mexico Indians contain beads of turquoise, many of them being gems according to modern standards. One of the most successful of the New Mexico mines is located near Los Cerrillos.

HOW SALT IS PRODUCED IN OHIO.

Salt in the United States, of which our annual production is close to 21,000,000 barrels, is obtained by various methods. In some states it is mined like so much ore or coal. It is obtained from the ocean waters by operations of evaporation and crystallization. Shallow vats covered by sheds and covering acres of ground are often used in open-air methods of evaporation in salt-making. Once made, salt is stored in vast quantities, such as that shown in the photograph, which represents not less than 20,000 tons, standing in a building 250 feet long by 135 feet wide. This photograph, together with the one of the cooling tower, pictures the industry in Cuyahoga county, Ohio, a notable salt-producing center. The method of production there employed is herewith described:

Twenty Thousand Tons of Salt in a Storage Warehouse

Wells lined with casing pipe are sunk down into the rock salt, which lies in a strata in the valley of the Cuyahoga river, and at a depth of 1,500 feet or thereabouts. The diameter of the wells is 6 inches. Brine containing 25 per cent of saline matter is brought to the surface by forcing water down one pipe by means of pumps, this



The Immense Coaling Tower Used in Preparing Salt for the Market

water coming up in a parallel one, bringing the salt with it. The forcing of the water is necessary on account of the specific gravity of the brine. After being brought to the surface, the brine is piped to wooden vats, 120 feet long and 15 feet in width. Then after being freed from sediment it is conducted to vacuum pans, where by means of steam pipes heat is supplied from within, the brine boiling and vaporizing at a temperature of 120 degrees. The brine is made to circulate freely within the vacuum pan. With the concentration of the brine, the fine grain salt leaves the pan and is carried in its slushy form to bins, where it is drained. Later, in revolving dryers it is subjected to hot air blasts.

By means of the cooling tower upon the roof of one of the salt-making establishments, the same water is used over and over again in condensing the vapor from the vacuum pans. Water once used is carried to the roof at a temperature of 120 degrees. It first enters troughs 10 feet above the roof, from which it is later distributed to the roof beneath. It is returned to the pan at a temperature of about 60 degrees.

Modern methods have revolutionized salt-making until now the best grades, it is said, often contain less than one-half of one per cent of impurities. The United States having outranked Great Britain within the past seven years, now leads the world in the production of salt.

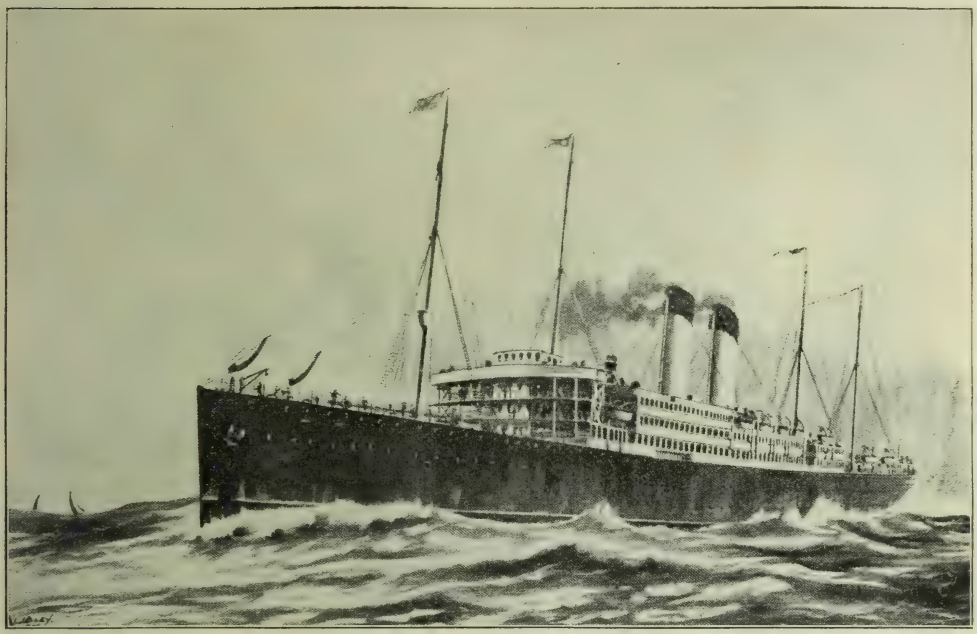
AUTO PROPELS A FIRE ENGINE.

To save a town from flames an automobile with a fire engine hitched to it made a mad run from New Washington, Pa., to Springdale, Pa., over 15 miles of country roads. When the engine arrived it was found that the hose would not fit and several houses were burned before the fire was extinguished, but the long, hard ride showed what an automobile can do in an emergency.

GREAT SALT LAKE SPANNED BY AN AERIAL CABLE.

An aerial telegraph cable 35 miles long and carrying 19 wires is to be stretched across the Great Salt Lake by the Southern Pacific and Western Union railroad lines, and over this aerial line will pass all the commercial-telegraph business between Salt Lake City and the western coast. The waves and high winds necessitated the cable.

Largest Vessel Ever Built Makes Her First Trip



The White Star Liner "Baltic," the Largest Vessel Afloat

The White Star liner "Baltic," which has completed her initial trip across the Atlantic waters, is the largest vessel ever built. She is 725 feet 9 inches long, 75 feet beam and 49 feet deep; her displacement is 40,000 tons, and she is nearly three times as heavy as the largest battleship in the English navy. Her speed (average, 17 knots) is moderate, but her accommodations are comfortable and luxurious. The grand dining salon, which is situated on the upper deck and extends its full width, is very handsome, and will seat 370 people. The Shipping World, London, says: "She is by far the largest vessel afloat, having a gross tonnage of 24,000 tons, and exceeding by 3,000 tons the 'Cedric' and 'Celtic,' which have hitherto eclipsed in size all other vessels afloat."

The "Baltic" can carry 3,000 passengers and a crew of 350. The smoke-rooms, promenades and libraries of each class are fitted up most luxuriously. Rooms en suite may be had by those willing to pay for these greater luxuries. The engines of the vessel are so balanced that vibration is almost entirely done away with. The heating and ventilating arrangements are most complete. She is provided with large refrigerating chambers, and in every detail represents the most modern type of commodious ocean liner.

Her cargo capacity is for about 28,000 tons, and her winches and other loading and discharging arangements are of the latest and most efficient type. She has a carefully planned system of water-tight compartments, and carries several important safety devices. One of these is an electrical indicator for preventing collisions, which indicates the exact position of any other vessel entering its magnetic zone, a radius of five miles. Other devices are the electrical lead and log, which indicate the speed of the ship and the depth of the water at 10-second intervals.

The "Baltic's" first trip occupied 7 days 13 hours and 3 minutes, and her 48 furnaces consumed 235 tons of coal per day.

China's one electric railway is 30 miles long. A 90-mile line is now proposed which will connect Shanghai, Hangchau and Suchau, cities of over a million each.

Scenes from the Great Conflict

The bridging of the Yalu was planned with wonderful foresight and system. When the Japanese were ready to use the bridge, not a part essential to the success of the venture was lacking. For many a day a long line of light transport carts, in charge of coolies, was bringing the great number of planks needed for the bridge over which the intrepid soldiers were to march, many of them to death.

The Japanese use the men who do not quite come up to the physical requirements for soldiers, as coolies for all such preliminary work, and this has wonderfully aided them.

Coolies Moving Planks on Light Japanese Transport Carts to Bridge the Yalu

The Russians declared that while scarcely a building may be left standing in Port Arthur, the fortress would never fall. The scenes within the city were such as would strike terror to the bravest heart. Hardly a whole pane of glass remains in any building, the streets are filled with debris and the shattered buildings with the wounded.

While the fighting was going on at Wolf Hill, north of Port Arthur, eight trains were kept busy bringing the wounded into the city. Vehicles of every kind were utilized, and many came on foot, though sorely maimed; many fainted by the way, too weak to go on.

The Cossacks, with their fierce mien and superior stature, well-mounted and world-famous for their bravado, make an impressive and formidable array beside which the Japanese might appear at a decided disadvantage.

But if the "yellow dwarfs," as they have been derisively termed, suffer in point of physique, they have far eclipsed their famous opponents in point of bravery, daring all things for the success of their cause. Bitter, indeed, it must be for the imposing Cossack colonel to surrender to these despised troops of infantry. But the scene has been enacted again and again, often with a strategical wit and a power of resistance on the Cossack side most conspicuous by its absence.

When, after two days' severe fighting, the Russians began to evacuate Newchwang, they left little behind them for the victorious Japanese. Buildings were totally demolished, the railway station was fired, and the heavy siege guns dismantled and made utterly incapable of further use.

The losses on both sides were heavy, but from the first the victory was with the Japanese. Their firing line, it is said, extended fifteen miles, and the storm of shot and shell did not cease until the last plain and hill had been swept clear of the Russians.

A church-car is in use on the Trans-Siberian line, which has the appearance on the interior of a beautiful cathedral. From chancel to windows every detail is carried

"Within the Beleaguered City Terrible Scenes Were Enacted, the Streets Were Filled with Debris and the Shattered Buildings with the Wounded"

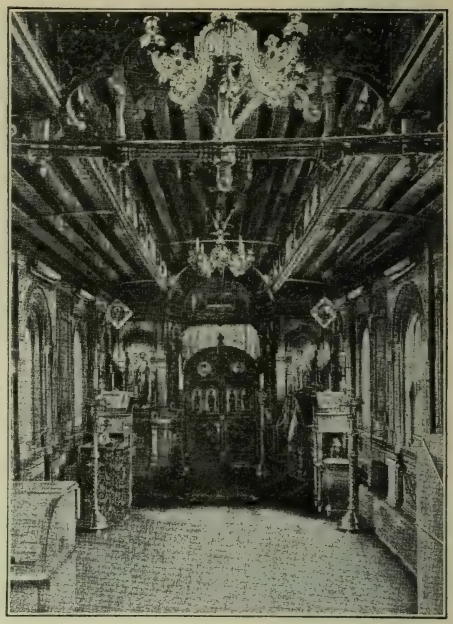
A Cossack Colonel Captured by Japanese Infantry

out and no Russian could ask for a place of worship more in keeping with the spirit of his rites.

When the work of constructing the great Trans-Siberian Railway was going on the chapel-car went with the employes of the

Russians Dismantling Siege Guns at Newchwang

road and was in constant use by them as they slowly advanced across Asia. The fact that the most uncouth, the roughest,



Interior of Church Car, Trans-Siberian Railway

the most brutal Russian must have his place of worship presents a strange condition of affairs. No other country, probably, has greater internal disturbances, no other rulers have more to fear at the hands of the people than do Russian officials, and yet everywhere we behold these people bowing down in worship. Superstition rather than religion is the impelling force, however.

Exterior of Chapel-Car, Trans-Siberian Railway

A Furious Fight in the Russian Trenches at Port Arthur

The Japanese in battle are like demons turned loose. They stop at no obstacle; they rush into the very jaws of fate with death-dealing thrusts, dying themselves, perhaps, in the encounter. Once scorned and despised by the Cossacks, they now are feared and hated. Yet if the Japanese is a demon in battle, he goes quite to the other extreme in the presence of sickness and injuries, and with a sublime forgiveness ministers alike to friend and to the foe, who has been so brutal to Japanese slain.

PEANUT OIL, ITS MANUFACTURE AND USES.

Making oil from peanuts is a growing industry in France. The oil is used as an edible, as a lubricant, and for making soap and other purposes. The makers of French toilet soaps, however, are the most liberal purchasers. The meal that is left after the oil is extracted is sold for cattle feed, as which it is keenly appreciated. Marseilles is the great market of the country for the peanut oil and meal.

Before pressing the peanut, the kernels are freed from the red cuticle by a winnowing process. Some Americans who have experimented in manufacturing the oil, pressed this red skin and the nut together and as a result the oil was extremely bitter. Often the nuts are subjected to three pressures, but the best oil comes from the first pressure. The standard size presses are used in Marseilles, in one of which the hydraulic pressure is about 1,102,300 pounds force. In most factories the meal, after being removed from the press, is placed in horsehair bagging, and sometimes it is placed in steel boxes without any wrapper.

OUTTURNING PROPELLERS FOR BRITISH VESSELS.

An important change will be made in all British naval ships built in the future: the engines will be so designed that the screw propellers will turn outward instead of, as hitherto, inward. Inward turning screws cause a loss in maneuvering qualities and in propulsive efficiency, it is stated, and the fact has been noted both in Italy and in France.

Inturning screws allow the engineer a good view of the engines at all times, and to secure this feature with the outturning screws heavy columns must be built in front of the engines to take up the thrust of the crosshead and connecting rod. The added weight of these columns is an important consideration in building warships. In naval machinery round forged steel columns are used and the engineer can see all parts at a glance. The new cruisers will have the starting platform in the wing of the ship and the back columns of the cast-iron form with slipper guides for the thrust of the crossheads and connecting rod will be placed next to the longitudinal bulkhead.

FELL 800 FEET AND SURVIVED.

Sensation is One of Pleasure—Consciousness Remains Until Striking—Heard His Own Fall.

Nature seems to wrap some of the most awful tragedies of life in pleasant dreams and soothing melodies. The old theories regarding falling from a deadly height were that the victim quickly lost consciousness by the rapid descent, and the terrible impact at the last was painless because of nature's anesthesia. Recent studies of the subject, however, prove that sense of pain is absent, the mind, sight and even sense of hearing remains as long as the body is descending, then the curtain falls on all sensibility.

An article contributed by Prof. Heim to the Psychical Review gives an interesting account of the sensations of falling from a great height. Prof. Heim has collected reports from those who fell from great heights and survived, and he has come to the conclusion that the experience is rather pleasant than otherwise.

The man who is falling from a great height has no pain, no fear, no sensation of despair. On the contrary, although fully conscious of the terrible danger of his position, he is calm and so resigned that he can review the causes of the mishap with perfect control of his thoughts. Toward the end of the headlong descent, the victim hears wonderful melodies, and, he feels as if he were floating into heaven, borne on rose-colored scented clouds.

He loses consciousness at the moment when he strikes the ground, but feels no pain whatever. The sense of hearing apparently remains in activity longest, for men who have survived falls of this kind state that they can distinctly remember the thud made by striking the ground.

The well-known Alpine climber, Sigrist, wrote as follows to Prof. Heim:

"When I fell from a great height on the Capfstock in the Swiss canton of Glarus, I retained full consciousness. I felt no fear but I had the sensation of floating downwards agreeably and safely. I was able to think calmly about my own position and hastily reckoned up the means left for my wife and family to live on after my death. When I struck the ground I became unconscious without the least sensation of pain."

Prof. Heim adds notes of his own feeling when he fell 800 feet and only escaped death by dropping into deep snow at the bottom. He writes:

"I did not lose my breath, but I thought clearly about my death. I pondered over the way in which it would be received by my relatives, and the copy which they would supply the newspapers. I speculated on the length of my own obituary notices. I heard wonderful melodies and I experienced a feeling of perfect peace and rest. When I recovered consciousness, two hours later, I could remember nothing about the actual contact with the ground, except that I had seemed to run against something black. I felt no pain whatever.

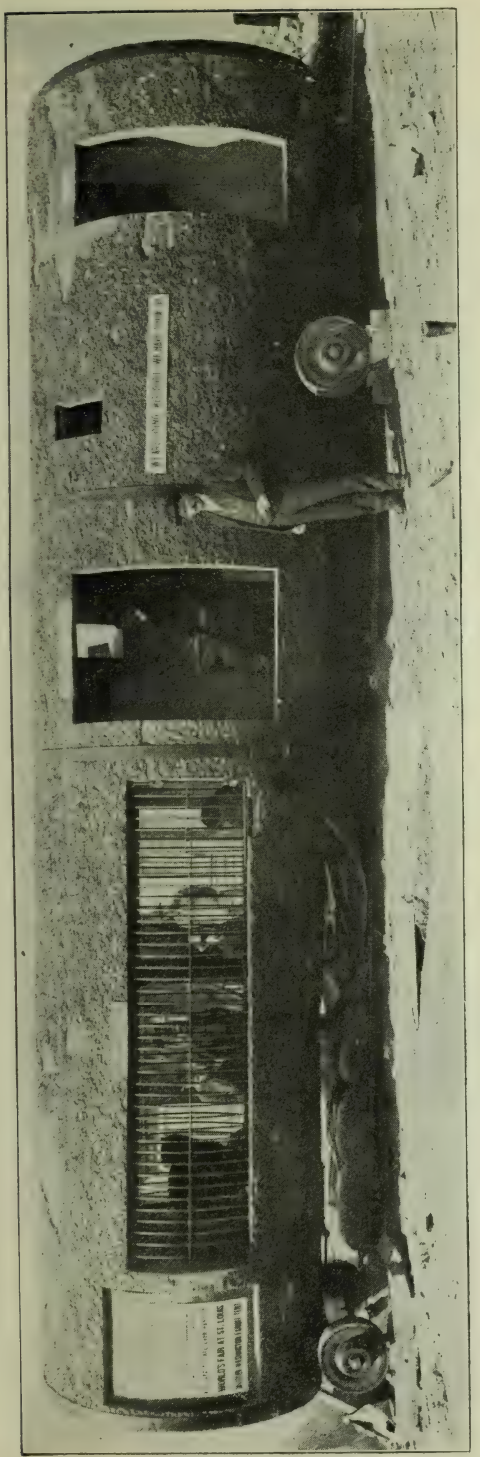
A NEWS BUREAU RUN BY TELEPHONE.

A telephone information bureau is conducted by a big Philadelphia daily to the satisfaction and great convenience of all the line's subscribers. No difference what the question to be settled, from the price of potatoes to the important matters of the day, the telephone bureau does its best to answer it correctly in the shortest time possible. Many hundreds of people of every class and calling call up the bureau every day and one and all are impartially answered.

The switchboard in use consists of a horizontal energy board and is equipped with twenty incoming trunks and one outgoing trunk, says the American Telephone Journal. The instrument equipment consists of seven portable desk sets and four breast plate transmitter sets; all having head band receivers. The board is so arranged that it can be operated with one or twenty operators, as needed, by means of switching keys. A party calling up the bureau is connected with a trunk that is not busy bringing up the lamp signal. One of the operators takes up the call and receives the query. When possible, the answer is given at once, but if it is necessary to look up the answer, a shunt key is thrown into circuit holding the signals at the telephone office.

The average number of questions received and answered in one day is over 2,500, and on special occasions it has reached nearly 4,000.

The head of a big automobile concern puts the sum total of the automobile business for this year at $24,000,000, or twice the amount for last year. Business vehicles are to receive the special attention of manufacturers next year and the figures for 1905 will probably see an even greater increase.



TRAVELS TO THE WORLD'S FAIR IN A LOG.

Across the western country from Gray's Harbor, Wash., to St. Louis, Mo., has lately traveled the most remarkable car that ever struck the rails. Before it was prepared as an exhibit for the Louisiana Purchase Exposition it formed a considerable portion of the trunk of a gigantic spruce tree that stood 271 feet in height and was the converging point of two trails that led from the heart of the mighty wilderness, and which the feet of numerous red men years ago wore hard and smooth as they assembled beneath that generous shade in council.

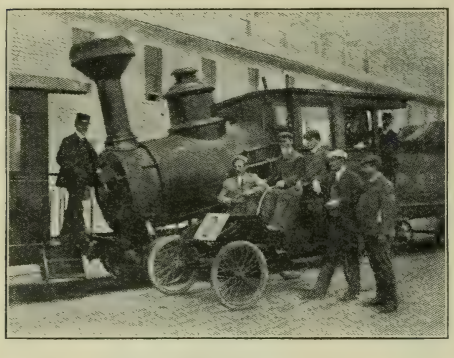
For 450 years, from the early days of American discoveries to the present time, it had safely withstood the warring elements.

From the base of the trunk to the first limb the tree measured 118 feet, and 40 feet above the base it was severed, its diameter at that height being 11½ feet. In making the car for the Exposition, 9 feet was the largest diameter the railroad would permit because of bridges and tunnels which would not allow of a wider car. Therefore 36 feet of the 9-foot trunk was hollowed out to form a reception hall, an office, an animal den and a register. In the animal den were caged animals from the Washington forests, including a man-attacking cougar and a bear. In the other apartments are a table, a chair, desk and two large couches carved out of the log and beautifully polished, showing the natural grain of the wood. In the reception room is a piano, and the capacity of this room is for 30 people. Three doors give entrance to the log while a number of windows afford plenty of light. Over $8,000 was expended in chopping down the tree, "logging" it to the Chehalis river, pulling it from the river and preparing it as an exhibit; to this expense must be added the cost of transportation. The log weighs 32,000 pounds; it has been placed on heavy trucks and it would require from eight to ten teams to haul it. The idea for the exhibit originated with Wm. Hepfinger of Aberdeen, Wash.

Within this novel "special," John P. Morgan made his long trip to the Fair, and later will go on to New York in order that the huge log may reach the eastern coast. The exhibit will probably be taken to Europe. Sections of the tree have been sent to the Royal Park, Stockholm, Sweden; Central Park, New York, and the Smithsonian Institute, Washington, D. C.

AUTOMOBILE CONTEST GOAL AMONG THE CLOUDS.

Climbing Mt. Washington in record-breaking time is a harmless little sport that



Auto and Rack Railway Locomotive at Top of Mt. Washington

automobilsts have taken up with considerable zest, and the enthusiasm and delights of the annual international contest hardly surpass those to be found in the daring dash which lures death at every turn. At the signal to start the mechanician and the driver forget everything but the speed to be maintained, and up the rugged road, which is open to automobilists but once a year, plunges the car. On, on and up it goes, careening past dreadful precipices where a single swerve would hurl it to destruction, now in the shadow of some towering ledge with unknown obstructions around yonder curve. With every pulsation the loose rocks and boulders go hurtling down the yawning abysses and every yard forward brings nearer the billowy clouds, which finally swathe the car and occupants in mists and mystery, and then, before it is realized, the finish is in sight and the air, at the altitude of 4,600 feet, resounds with cheers. Has he broken the record? Yes, the shortest time yet made. But the triumph is shirt-lived, for a few moments later another panting vehicle comes in with a shorter record yet.

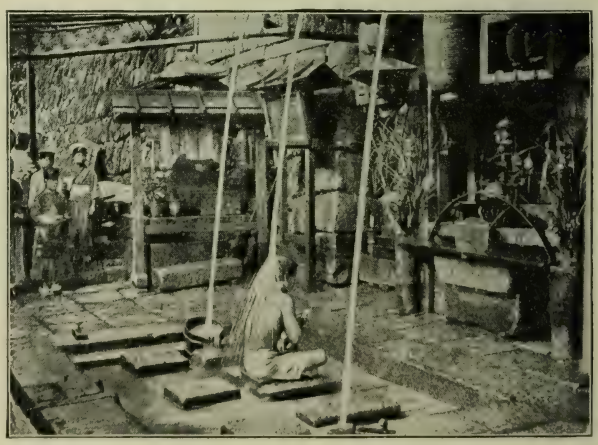
This year Harry Harkness, driving a 60-horsepower $18,000 Mercedes car which weighs 2,200 pounds, made the 8-mile ascent at the rate of 20 miles an hour or in 24.37 3-5. The nearest approach to this record was made by F. E. Stanley with a 7-horsepower steam auto. His time was 28:19 2-5.

For several days automobiles and motorcycles joined in the contests, and even the old rack road locomotive broke its own record by making the descent one day in 50 minutes, 5 minutes less than its shortest previous record. A drizzling rain did not dampen the spirits of the automobilists, but it seems that the descent did. Some left their cars for their mechanicians to bring down and themselves took the safer route by rail. The descent was hard on most of the cars, in some makes the brakes hardly affording sufficient clutch, and it was necessary to water the brakes. The average grade of the 8-mile climb is 17 per cent.

WASHING THE LIES OUT OF A JAPANESE BOY.

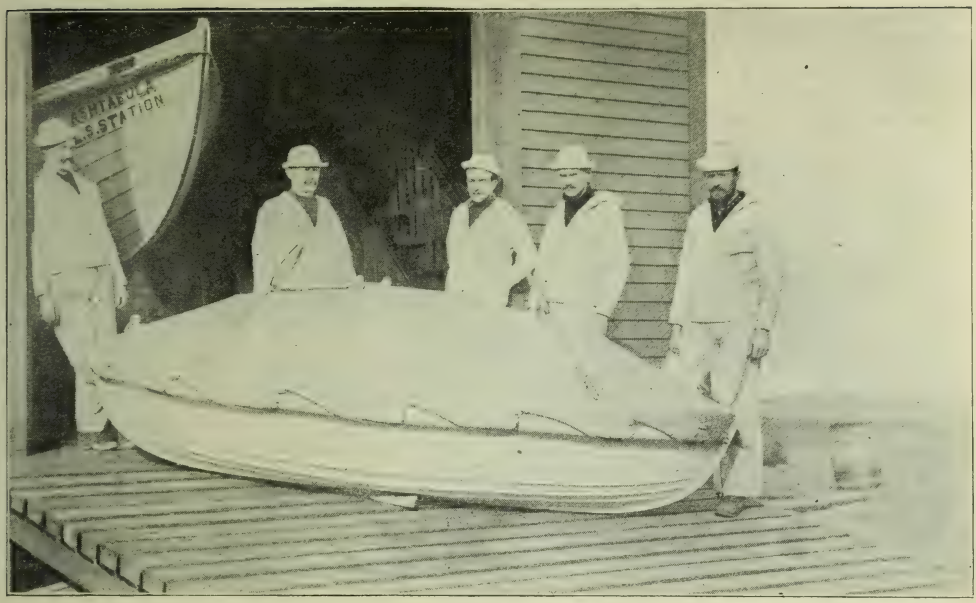
The Japanese youth's religious training, although it includes many heathen rites and beliefs, is much better cared for than the average American boy's. Every morning at a shrine in his home where is enthroned a family saint or one of the Seven Gods of Riches, the little fellow makes his offering of a cake, a little rice and a sprig of green, and at night he lights a little lamp in front of it.

But the strangest of all the observances is his method of cleansing himself from various sins by means of water. The boy in the illustration had told many lies, therefore he seated himself for a time under the stream of water just so it dashed against his neck and bare back. Let any American boy try it as a cure for lies and see how he likes it.



Japanese Boy Before a Shrine Having His Lies Washed Out

New Type of Lifeboat.



This life car is made of galvanized iron, and is drawn out to the wreck by a life line fired from a cannon on shore. It is about ten feet in length and will hold four people. After the persons to be rescued from a shipwrecked vessel are placed within through the entrance at the top, (as shown by one of the crew, in the cut) a covering is placed over the opening, thus allowing the waves to dash over it without even wetting the occupants.

RAILROADS OF THE WORLD.

Figures have been compiled showing the miles of railroad in the world at the end of 1902. The difference in the number of miles of track between the New World and the Old will cause surprise to many Americans:

Europe	183,997	North America	233,186
Asia	44,358	South America	28,822
Africa	14,554	Australia	16,038
Old World	242,909	New World	278,046

This makes a grand total of 520,955 miles for the whole world, of which 53 1-3 per cent is in the New World and 44¾ per cent in North America.

The Railroad Gazette says: "The additions to the railroads of the world for seven successive years have been, in miles: 1896, 9,796; 1897, 10,747; 1898, 10,864; 1899, 13,533; 1900, 10,800; 1901, 16,551; 1902, 13,338.

"This gives a total of 85,629 miles for the seven years, being an average of 12,233 miles per year. The average mileage built was greatest from 1880 to 1890, when it was 15,218 per year."

COSTS MONEY TO LAND IN PANAMA.

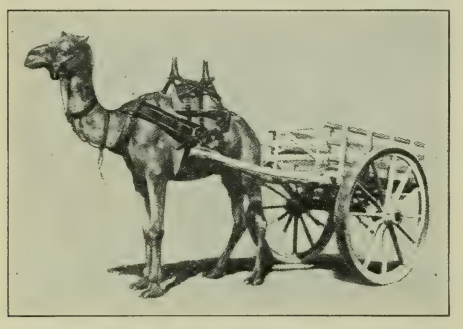
Immigrants to Panama over 18 years old are required to pay a tax of $4 if a first-class passenger and $2 if a second-class passenger within 24 hours after landing. If this is not complied with the agent of the vessel landing them is subject to a fine of $4 for each foreigner landed. The laws regarding criminals, diseased persons, anarchists, etc., are very strict and authorities violating them incur heavy penalties.

The question of an automobile emergency hospital for Chicago's downtown district is being agitated. If the plan succeeds the movable hospital will also serve as a free dispensary for emergency cases.

NEW SCHEME OF DESERT TRAFFIC.

Cairo Firm Hitches Camels to Queerly Constructed Carts

The Oases Syndicate of London has inaugurated a new method of desert transportation. It is to hitch a camel to a cart and haul the traffic in the cart instead of on the camel's back. The illustration shows the first cart to be drawn by camel



The Ship of the Desert in Harness

traction across a desert. The trip was made successfully from Cairo to Kargheth Oasis. The carts were built at Cairo. They are two-wheeled, as experiment proved that the powers of the camel can best be utilized by causing him to take a certain amount of weight on his back. The wheels are 5 feet in diameter, with ordinary felloes of oak, spokes of ash and a ⅜-inch tire. Outside this tire is shrunk and bolted on a 5-inch sand tire 3/16 inch thick. Sloping pieces of light timber are screwed on to the felloes so as to prevent sand from lying on them in soft ground. The sides and ends are movable. The carts carry more than two tons each.

NO MORE THE TOWPATH.

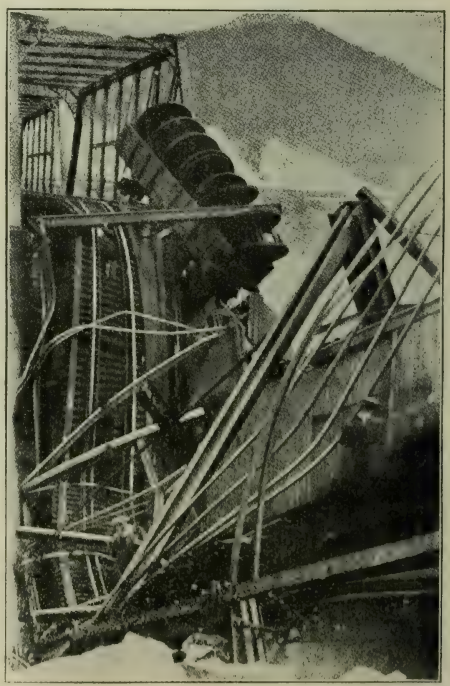
The canal towpath, famed in song and history as the starting place in life for many of our greatest men, including one president, is not likely to furnish any more. The plodding mule is going to give place to the electric mule and the barefooted boy who wielded the willow switch to an electrician who will use a switch of entirely different construction.

The trolley on the canal promises to revive the old time system of transportation, and to again bring into service hundreds of miles of waterway which have been practically unused for years.

DERAILED FREIGHT TRAIN WRECKED A BRIDGE SPAN.

A derailed freight car wrecked a span of a big bridge of the Lehigh Valley Railroad not long ago so that the entire span, 164 feet long, fell into the river, carrying with it a number of freight cars.

The bridge consists of eight through spans of moderate length, two trusses to the span, carrying a double track and crosses the Susquehanna just south of Towanda, Pa. A broken wheel flange caused the derailment of one car of the south-bound freight when about 300 feet north of the bridge. The car struck the inclined end post of the bridge, breaking it in two. The span fell into the river, badly broken up and all the rear part of the freight except four cars ahead of the caboose went down, the track rails holding together and pulling about 50 feet of track off the grade into the river. No one was hurt, though two tramps who were in the last car over, which remained tilted on the pier, had a bad scare. A temporary trestle was erected and traffic, which had been transferred over a public bridge one-half mile south, was soon resumed.



Wrecked Span of Towanda Bridge

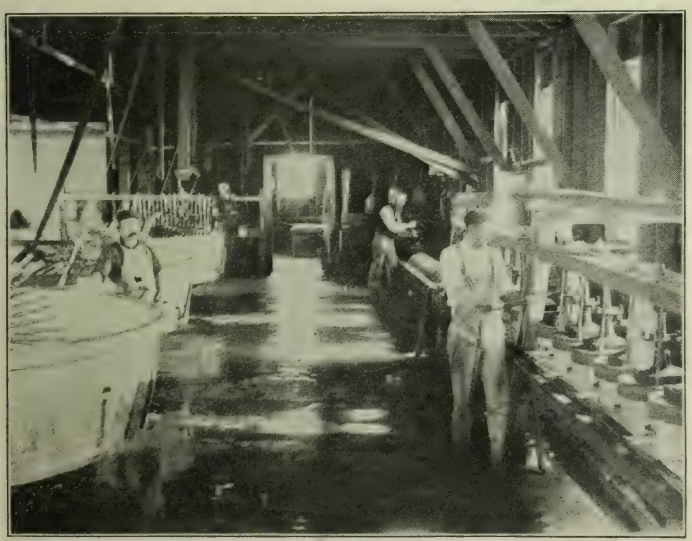
How Cheese is Made

Sugar of Milk Also a Profitable By-Product

There has been a marked evolution in cheesemaking since the early days of the industry when the farmers made curd at home and then took it to the factory to be pressed into cheese. Today the cheese factory is a place of modern invention and skilled labor, and in all modern industries the by-products are utilized. Sugar of milk is an important part of infant foods, and is also used in making tablets and pills.

Milk is received at a modern cheese factory and is emptied into a receiving tank holding 600 gallons. This tank rests upon scales. After the milk has been weighed it goes through pipes into the vats within the factory. Milk received at night remains in these vats till morning, the souring process which is constantly going on in milk being conducive to cheesemaking, as is also the mixing, in the morning, of the sweet and slightly sour milk. Modern vats used in the cheesemaking processes are round in shape and contain about 7,000 pounds of milk each. Between the lining and the exterior portion of the vat there is a compartment into which hot water is piped from the engine boiler, and is kept at a temperature of 85 degrees or thereabouts, and serves to properly scald the milk. Rennet, a liquid made from the stomach of a calf, is used to coagulate the milk, a few ounces being sufficient for 1,000 pounds of milk. Today this rennet is bought by cheesemakers already put up in bottles. In early days it was made by the cheesemaker himself.

Boiling Whey in Making Sugar of Milk



The Interior of a Cheese Factory Showing Vats and Presses

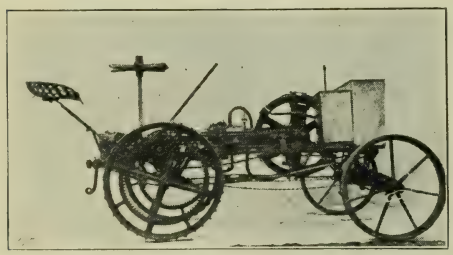
Machinery has now taken the place of cutting curd by hand, and also the work of stirring. What is known as an "agitator" is used for stirring, and, together with the curd knife, is run by steam

power. After the curd has formed and has been sufficiently cut to liberate the whey, a small piece of it is placed upon a hot iron. If it adheres to the iron it is ready for the presses. It is then taken from the vats and placed in telescopic hoops, drawn out to their full height. Cheese capping cloth is placed within the hoops and the curd fills them to the brim, after which the cover is put in place and screws, capable of raising a building, are applied. The hoops telescope as the pressing process continues and the curd becomes cheese. When taken from the presses the cheese is taken to the dryhouse and placed upon racks. What is known as a gang press, which will press twenty or more cheeses at once, is often used instead of the individual presses.

The whey, which is the recrement liquid from the cheese factory, goes by way of a trough to the sugar of milk factory nearby, and is placed in vats of 500 gallons capacity, where it is boiled. Next a small quantity of diluted sulphuric acid is added, which causes the casein and fat to separate and leaves the sugar liquid. The casein—the coagulable part of the whey—settles to the bottom, and the fat comes to the surface. The sugar liquid thus separated is emptied into tubs. Having been boiled down into a saline mass of brown color, it is ready to crystallize. Hard yellow crystals form about the sides of the tub and about a stick placed therein. The remaining liquid is again put into the vats to be boiled, and the crystals are removed by the aid of a hatchet and are placed in bins. They next go to the refinery. Here they are repeatedly boiled, crystallized and decolorized, and finally ground by machinery to powder form, when the product is ready for the market.

FARMING BECOMES A MECHANICAL OPERATION.

The farmer is fast becoming an engineer and mechanic, and the next few years will see the general use of traction engines for farm work.



A Handy Farm Automobile

On the farm of Louis Noltemeyer, near Columbus, O., a novel machine for everyday farm work has recently been successfully tested, and is now in use in place of horses. This machine is an auto traction engine, which is so fitted that Mr. Noltemeyer can hook to it two plows, a corn planter or other farm implements, and when occasion requires it can be converted into a wagon for hauling. It can also be used to operate a thresher, a pump or a drill.

The engine of this machine is water-cooled. It is 10 horsepower, but the gearing is such that the actual power developed at the wheels is equivalent to 40 horsepower. A much larger machine of the same kind will probably be built in the fall.

JAPS DRAW THE LINE AT MACKINTOSHES.

Japanese have demonstrated their willingness to wear American and European fair-weather clothes—they have adopted our style of neckwear, our make of coats, vests and in some instances our trousers—but they draw the line at the white man's mackintosh or rain coat. They say it doesn't keep off the rain, and so it is often occurring in Japan that the people will be attired in modern European clothes, but still wearing their old-fashioned rain coats of straw. The coats are light, comfortable and waterproof.

Members of the Anti-Russian League of Japan Wearing Rain Coats

How To Build a Telephone Line By Using a Wire Fence

50-Mile Telephone System at Marlow, Indian Territory--Story of Its Construction and Successful Operation Is Told By the Builder

T. P. Martin, Jr.

A wire fence telephone line will not give perfect satisfaction during wet weather as ringing is difficult owing to the grounding by the wet posts. However, in a dry climate like that common to the South it will work nicely. Such a line was installed and used by the writer for nearly two years. Thousands talked over the line and few dreamed that their important messages were going over a common barbed wire fence. The line was run on the right-of-way fences of the Rock Island railroad from Marlow, I. T., to Rush Springs, and from Marlow to Duncan, 10 miles each way, making a 20-mile fence line, which was connected at Marlow with a 1-wire 2x4 post line, which had been hastily built from Marlow to Lawton, O. T., 30 miles distant.

The first piece of advice I shall offer is this: what you do, do with care and you will find that you have a convenient telephone line which will work with several 'phones on it, a distance of 20 miles during dry weather and, if very dry, you may ring 50 or more miles. Get only the best of telephones, about a 5-bar generator in what is known as the long distance bridging telephone. This will cost you complete about

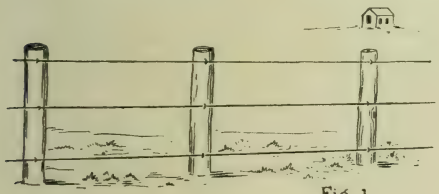


Fig. 1

$12, and is well worth the price. Poor material gives poor results, so get the best of what you do buy.

Get permission from all who own the fences between you and the friend you desire to have telephonic communication with. This is generally an easy matter. If the wire fences are three wires or more, the instructions following will apply for all.

Get some poles or pieces of 2x4 about 16 feet long and saw across and downwards at one end of each piece so that a wire laid in the cleft so made, will not slip over the ends of the pole (a nail driven into the end of the pole and bent down across the wire, or

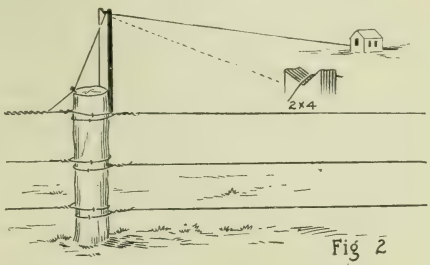


Fig. 2

a fence nail will do better). Now get some No. 12 galvanized iron wire, enough to run across all gates, roads, culverts, or other obstacles, and to run from the fence to each house you desire to connect with.

Begin at the fence in front or near the first house and after splicing the barbed wire from each side of a certain post and tying the splice around the pole, put two good staples on each wire, then cut the original wires in center. Be sure to staple the wires before you cut the original wire, or they will all slip and make the fence sag and look bad. Staple the wires at least an inch from each other so that you have six separate ends on the post of a 3-wire fence. Fig. 1 shows the fence as it is before touching and Fig. 2 after the wires have been cut.

This operation leaves you with the wires in front of you to look after and saves your line from being bothered by grounds or other causes on parts of fence which are not used by you. Join an end of your iron galvanized wire to the top fence wire, pass it over the cleft in the end of one of the 2x4 pieces, or the end of one of the poles you may have. Fasten it there with a bent nail or staple, nail your pole, or 2x4 to the fence post and run the iron wire to the first house, fasten it on the side of the house and cut off the extra wire for further use. Return to the fence and carefully

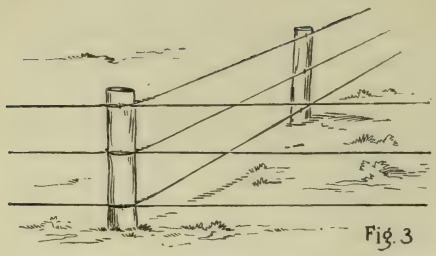


Fig. 3

follow it in direction of the next house you wish to connect with. See that all staples are in good, not only on the top wire (which will be the one used for the telephone line), but of all the wires, for you do not want any crossings, if possible, nor any sagging down and touching the ground by even the bottom wire, although you are not using it. The idea is to keep all the wires clear, for should they at any time become tangled with each other, it will not affect your line seriously unless the troublesome other wire should be grounded at some place.

Proceeding along the fence you will soon come to a cross fence. Fig. 3 shows how wires usually look on a fence where another joins it and Fig. 4 shows how you should fix all three of the cross fence wires so that they do not touch any of the three main-line fence wires. Be careful when separating them, to staple each wire well so that future visits for that purpose will not be necessary. Cut off all loose ends so farmers or small boys will not twist them around the wire you use. Next you may run across a wire gate, which many times is left lying on the ground. Fig. 5 shows such a gate and the way to pass it. Cut all wires loose at least one post from the gate on each side; two posts would be better, as much trouble often happens to 'phone lines at the gates. Two pieces of 2x4 are used here also as the drawing shows.

Fig. 6 shows how to cross a road, being similar to the manner of crossing over a gate. Observe that in every case all side fence wires or other obstructions are disconnected from the main line fence.

Fig. 7 is a hollow or creek fixed so that cattle cannot pass. The fence wires are usually tied to each other by smaller wires. These wires should be removed and replaced with a new strong wire and a small porcelain insulator between each fence wire so that while the fence wires are braced and held as before, they are insulated from each other. As such places are usually sources of annoyance, I would suggest the method of Fig. 8, although it is more trouble. This is the method used for crossing small rivers.

Fig. 9 shows a wire coming down a railroad right-of-way fence on one side, crossing under a culvert or bridge and going out on the other side. All three wires are disconnected on each side of the bridge or

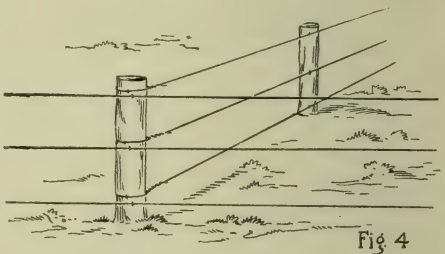


Fig. 4

culvert, similar to Fig. 2, and the connecting iron wire between the two sides of the culvert is run under and nailed to one of the cross-ties of the railroad track. If the ties are lying on the ground, a piece of heavy insulated wire nailed near the top, but on the side of a tie, will serve the purpose as well. In this latter case it is well to scoop out the sand next the tie so that in case of rain the water will drain quickly from each side of that particular cross-tie.

Fig. 10 is similar to Fig. 2, and is intended to show the end of the line. If, however, you desire to connect up several houses Fig. 11 shows how to do it. Each house is

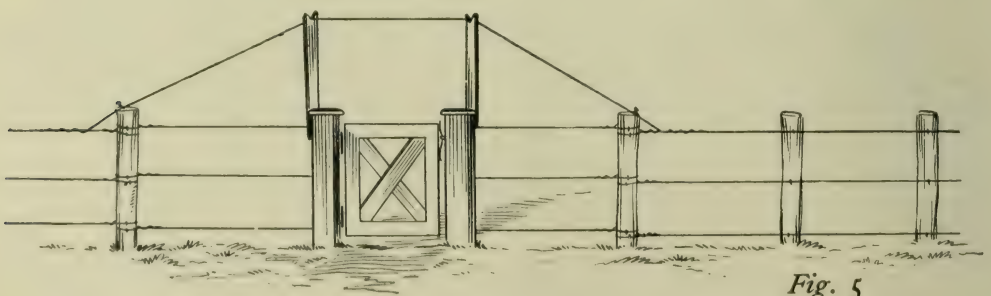


Fig. 5

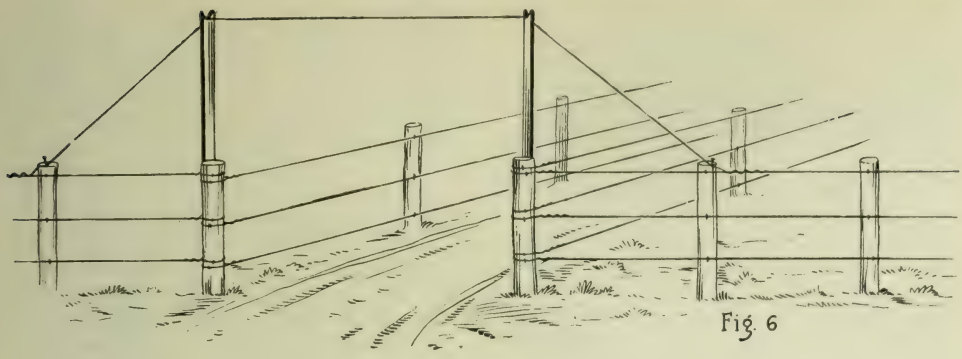


Fig. 6

approached and handled in the same manner as the first one, bridge 'phones being used with a ground wire at each house.

Fig. 12 shows how to place the telephone instrument inside the house, and Fig. 13 the fuse block and ground wire outside. After having attached your iron wire to the side of the house, bore a small hole through the wall (slanting upward from the outside so that wind and rain will not enter) bore another hole just above where you have decided to put the telephone instrument, and still another a few feet to one side of it. Get about 50 feet (to each house or 'phone) of No. 14 well covered insulated wire, copper preferred; take a knife and scrape away all the covering from one end of this wire for about two inches and run the scraped end through the hole at the top and just back of where you intend to put the telephone inside the room. Measure off enough of this wire to reach the ground and there scrape the covering for about six inches. Get a piece of iron rod about three feet long, an old wagon rod or stove rod will do, file each end of it bright for about six or eight inches, and wrap an extra piece of the copper wire around it (first removing the covering from the wire) many times, close and fast, soldering it if possible. Take your axe and, selecting a damp place at the bottom of the house, drive this rod down and under the house (where it is usually damp) until you have covered up the top of it, leaving sticking out the small wire you have wrapped it with. Now take some small double-headed tacks and neatly nail your wire from the 'phone, down the side of the house, along a crack where it will not show, to the grounded rod and there attach the two ends together. Cut another piece of wire about half the length of the wire already run to the 'phone, scrape each end well and join one end on the outside of the house to the wire already running to the ground. Run the other end through the next nearest hole and leave the slack inside

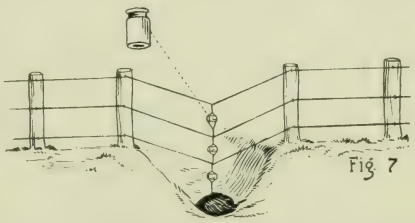


Fig. 7

the room until later. Now take your iron wire coming from the fence, fasten it up high where the cows will not break it down. Get a small fuse block and fuse from your local 'phone man, who will explain to you fully how to use it, and screw the fuse block to the house outside and well up under the eaves out of the rain. To the other end of the fuse block fasten another piece of insulated wire, well scraped, and run the end of this piece through the last hole you bored. Do not run two wires through the same hole and be careful to nail all wires down so the children will not be tempted to pull on them, thus breaking the line and giving you trouble. Now go inside and put up your telephone, with which directions are usually sent. Do not connect up the battery on your 'phone until after your instrument is up on the wall, for batteries run down or lose their

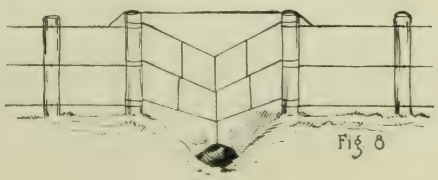


Fig. 8

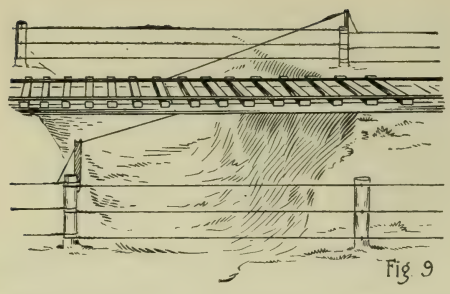


Fig 9

energy when in use constantly and a telephone on the wall is usually in a position where it throws the battery in circuit.

Get a small wooden 2-point switch with a little lever to it and fasten this switch to the wall immediately above and to one side of your telephone. There are small connecting posts under or on the lever and points, and to these posts attach wires as follows: to the lever itself attach a short wire and fasten the other end of it to one

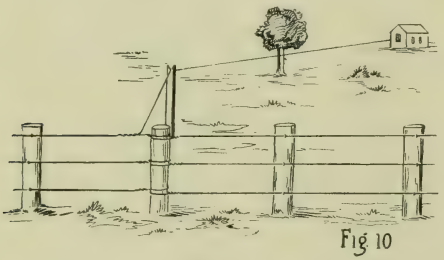


Fig 10

of the binding posts or screws at the top of the telephone; attach to one of the points, the wire which comes from the fuse block, and to the other point attach one of the wires that has been connected with the ground rod, now take the other wire, which also runs to the ground rod, and connect it to the remaining binding post at top of 'phone. Connect the battery in the battery box (put the small wire you will find there loose, under a binding post and screw it down). Now place the lever of your switch on the point the line wire comes to and see if you have left any loose ends of wires, for there should be none. Any

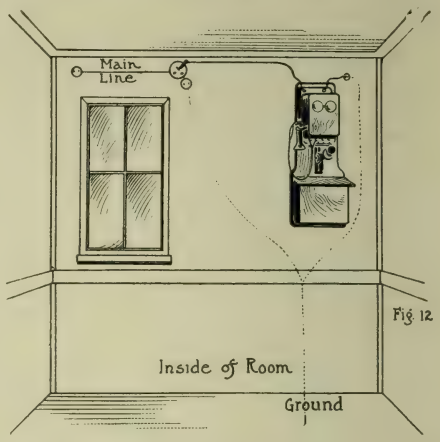


Fig 12

slack in wires may be remedied by winding the insulated wire around a wire nail or lead pencil. See that your fuse is well down in the block, that all screws and binding posts are well set, and, if such is the case, you are done here. Fix the next 'phone likewise and you are in readiness to ring your friend. The fuse block and fuse is for protection against lightning and the switch serves a similar purpose, and in addition is to be used to "test" your 'phone. If you find that you cannot ring, turn the switch to the other point and if it then rings, your 'phone is all right so far as ringing is concerned and the chances are that the line is cut somewhere. In case of lightning or a thunder storm you can turn the lever to the switch so that it touches no point at all. This leaves your line "open"

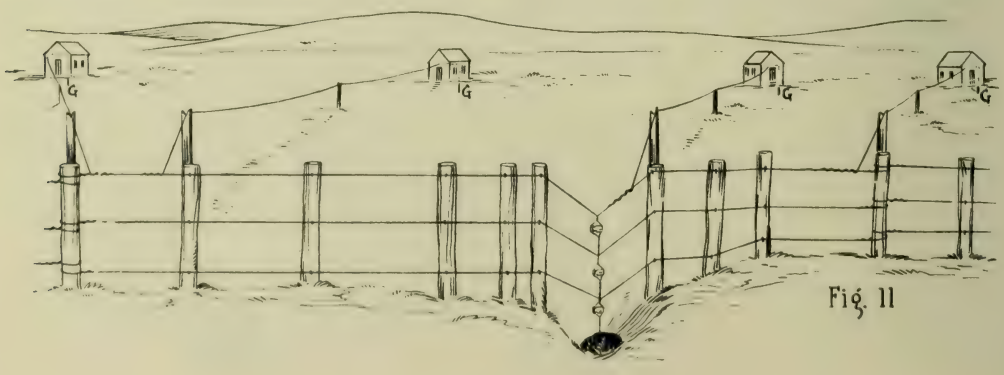


Fig. 11

and you cannot talk or ring anyone until you put the lever back on the point where the main line is connected. If, after putting

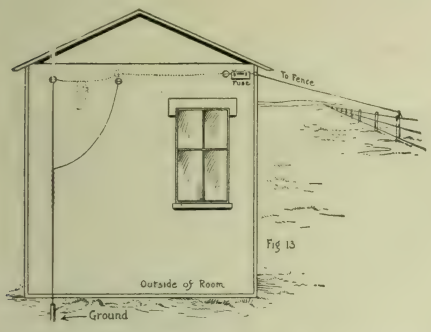


Fig 13

up both 'phones, the lines do not work, but test out properly so far as the instruments are concerned, the trouble is (and will be often if you do not follow to the letter directions given here) on the fence somewhere. Go over it again and when you see a place you are in doubt about, fix it. Then go back to your 'phone, leaving the other party at his and try again and you will doubtless have a pleasant surprise in the way of your first conversation over a barbed wire fence telephone line.

AFRICA IDEAL FOR COTTON GROWING.

England, in promoting the growth of cotton in Africa, has taken up a most promising field, as has Germany also. The climate, soil and native laborers of Africa are more favorable to cotton growing than they are in any other continent, and before 1905, in British Central Africa, alone, 200,000 acres of it will be planted.

British possessions in West Africa include 500,000 square miles, containing 20,000,000 negroes, and an output of 10,000,000 bales of cotton of superior quality per year is expected from that district.

That the market for the product is good is apparent from the fact that the average increase of the world's cotton output is 100,000 bales per year, while the average increase in population greatly exceeds it and cotton fabrics were never more in demand.

Egyptian cotton is noted for its silky softness, but in no other country save Africa has its seed produced good results. The establishment of transportation lines will make a great cotton territory of the Sudan as immigration to that part will be greatly increased.

FIRE ENGINE PROVIDES MUSIC FOR SCHOOL EXRCISES.

A fire engine returning from a fire provided the music for grammar school exercises that were being held in the First Presbyterian Church at Austin, Ill., recently. The big pipe organ at the church is pumped by a water motor, but owing to low water pressure the organ only gave a wheezing sound when the organist attempted to play. An alderman was in the audience, who went out and hailed a fire engine that chanced to be passing the church. By the aid of the fire engine and the blower the organ was pumped and the entertainment proceeded.

RAILWAY MOTOR SERVICE IN GERMANY.

Motor railroad cars for service on small local roads are now being built in Germany. The cars are to be of two sizes; the larger ones will pull a trailer of two tons gross and will accommodate the entire passenger, mail and freight service. Passenger service will be German third-class, the seats being unupholstered wooden ones. A separate compartment for passengers with heavy baggage will be provided or the space will be used for standing room in emergencies. These large cars, without the trailer, are capable of a speed of 46.6 miles.

The smaller cars will pull from three-quarters to one ton gross weight and will transport baggage and a limited number of passengers. The freight and regular parcels-post service will be handled by local trains. On main lines the small cars without trailer will have a speed of 37.3 miles, and on branch roads, 31 miles.

Besides these motor cars for railway service, street motor cars of five patterns for mail service are soon to be installed. Three of these are for use in inner cities while the other two types will be used on the highways in rural districts and will accommodate passengers, also smaller cars will be used to collect and deliver mail, and possibly freight, at points having no railroad connection.

Music to soothe the troubled minds of the insane is being used with great success at the Cook county asylum for the insane. One Chicago firm has recently donated six pianos to the institution.

WESTINGHOUSE CONDEMNS THE THIRD RAIL.

George Westinghouse, president of the Westinghouse Electric and Manufacturing company, says it is impossible to obviate the present dangers of the third rail and insists that there never was any good reason for the existing opposition to the overhead wire. The system of dividing the third rail into sections, with an automatic arrangement giving current to a particular section only when a train is using it, has been suggested as a protection, as has the covering of the rail with a hood. But these schemes, according to Mr. Westinghouse, can accomplish nothing more than a reduction of the danger. He advises that return be made to an overhead conductor which will obviate the danger entirely. Mr. Westinghouse says that the third rail is impossible for use at important junctions and terminals, that the Pennsylvania railroad does not intend to use it at all in its underground work between New Jersey and Long Island, that the Zossen high speed experiments were made with an overhead wire, and that the New York railroad commissioners have declared that they will not permit third rails on interurban lines which are crossed by highways.

HOW TO MAKE OILED CLOTHING.

The great difficulty in making oiled clothing is to keep it from being sticky. To prevent the stickiness it should be artificially dried at 150 degrees Fahr. On a hot day the sun will dry it sufficiently. Set as much boiled oil as necessary and if for black work, mix in enough lampblack to blacken the clothing; if for yellow, use ground yellow ochre instead.

Lay the fabric on a smooth surface and apply the oil with a shoe brush. Let the first coat dry well before applying the second. A half pound of patent drier to each gallon of oil used will make it dry more quickly. Lay the oil on as thin as possible.

POWERFUL ENGLISH FIRE ENGINES ON EXHIBIT.

Notable among the many handsome exhibits shown at a fire prevention congress held at Earl's Court, England, recently, were an oil fuel motor steam fire engine and a "double vertical" steam expansion fire engine, each the finest of its type.

An Oil Fuel Motor Steam Fire Engine

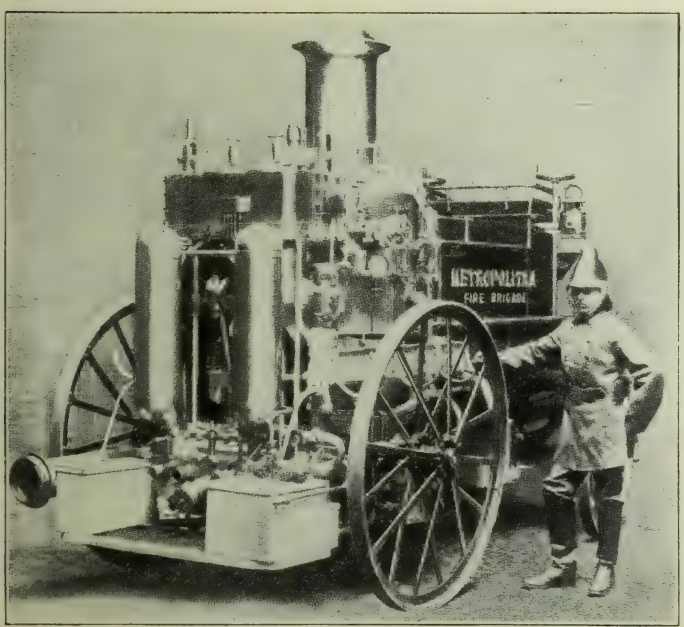
When standing in the station the oil fuel motor steam fire engine has about five pounds of steam in the boiler at all times, kept up by means of a gas jet. When a call is received vaporized oil is at once ignited, and inside a minute and a half the engine is out of the station and plunging away toward the fire. Its maximum speed is 30 miles an hour, and at all times its driver has it in complete control by means of the powerful brakes and steering gear with which it is equipped. Its pumping capacity is 320 gallons per minute, and in an instant the driving machinery can be thrown out of gear, the pumps put in, the hose being run out in the meantime, ready for use. The 36 gallons of oil carried in two cylinders are sufficient for several hours' work. On each side of the boiler is a storage tank for water and a main feed pump works while the engine is traveling; should this main feed give out, there is an injector handy.

For the "double vertical" variable expansion steam fire engine a quick-steaming boiler of the water-tube type, in which in

from five and one-half to seven minutes steam of 100 pounds pressure can be raised from cold water, furnishes the motive power. At the rear of this boiler are the steam cylinders and pumps placed vertically. The power of the engine can be regulated to the work to be done by variable steam expansion gear, which is an economical feature of the type. Oil fuel is used and 20 to 30 pounds of steam constantly maintained at the station. It carries a supply of oil for about 3 hours' action, and in working the oil is sprayed through several outlets on to a jet of highly superheated steam, which disperses it into fine molecules and forces it against a baffle-plate in the furnace. The furnace can be lighted while the engine is traveling toward the fire.

These "double vertical" engines are manufactured in seven sizes, the most powerful having a capacity of 1,000 gallons per minute. At the exhibit the power of this engine was demonstrated by throwing a stream from a 2⅛-inch nozzle a distance of 300 feet.

Another interesting exhibit was a portable engine having a capacity of 100 to 150 gallons per minute. This engine was especially designed for use on small estates and for institutions where it is desirable to have fire protection always available.



Powerful 1000-Gallon Steam Fire Engine

ASCRIBES SLOCUM HORROR TO AMERICAN GREED.

"Death Buoys," is the name given by the British Inventor to the life-saving apparatus of the "General Slocum." The British opinion is further expressed thus:

"To the American trader the sacredness of human life is a mere morbid sentiment which has no place in his composition, and if he can get in a deal he will make up some richly-painted and well-finished lifebelts filled with sawdust and sand regardless of the fact that this inhuman fraud may carry hundreds of victims to their deaths, as was the case in this last sacrifice to the rapacity and incapacity of those in authority."

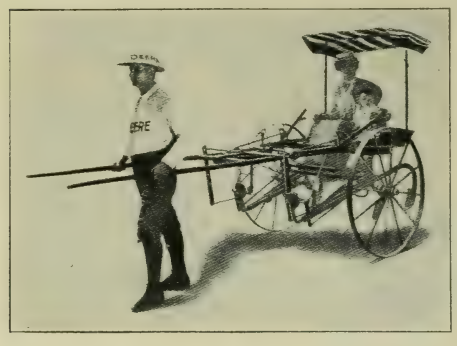
BROKEN LEGS CAN WALK.

Never more needs the man who breaks both his legs or fractures his thigh lie in bed for long weeks waiting for the broken bones to join and daily growing so stiff in the joints that when he is able to walk it will be a painful process. A German carpenter has invented a wonderful splint which enables the unfortunate with the broken bones to walk inside of three days after the accident, providing there are no complications.

Round the seat of the fracture is fastened a hardened leather case which fits the leg perfectly and the weight of the body is carried by jointed steel rods attached to another case fastened above or below the knee, according to the place of fracture. The London Hospital has used this appliance with excellent results. A man with a fractured thigh, admitted on February 2, walked across the ward on February 4 by means of the splint and was up every day thereafter. The tests by the hospitals are the best the invention could have.

THREE HUNDRED MILES ON A CULTIVATOR.

Of all the various means of transportation utilized to reach the St. Louis fair that of William Hoyt, of Moline, Ill., is thus far the most unique. He is connected with a manufacturing concern which makes farm implements, and he conceived the idea of walking the 300 miles from Moline to St. Louis, drawing the machine, with his wife and boy as passengers. The trip was made in safety and occupied three weeks.



En Route for the World's Fair.

NEW MAMMOTH FREIGHT LOCOMOTIVE.

Towering 20 feet high, this great mass of steel and iron weighing 118 tons instantly attracts attention from all who witness its almost irresistible progress. In its tender is sufficient coal to last two families all winter, while its supply of water would fill a good sized swimming pond.

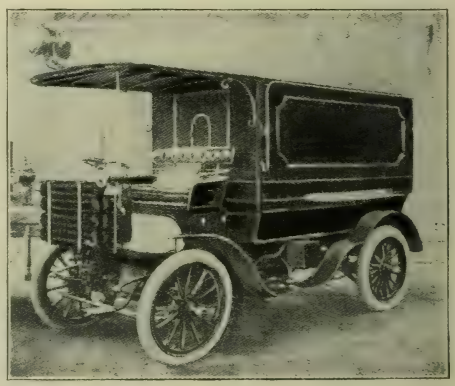
Within the past few months the Lake Shore Railroad has been installing some mammoth locomotives of the consolidation type for use in the heavy traffic of iron ore between the lake port of Ashtabula, O., and the furnace districts of Pittsburg. Since their introduction some excellent records for tonnage have been made. During the early part of July trains of ore weighing, exclusive of the locomotive, 3,500 tons have been sent south from Ashtabula. After leaving the steep grade at a point near Ashtabula one locomotive hauled these trains via the new low grade ore-carrying line upon which the Lake Shore expended hundreds of thousands of dollars in building. Previous to the record made in July the best former record since the introduction of the mammoth new engines was a tonnage of about 3,000 tons. The latest record will be improved upon, it is expected, in the near future.

The weight of the new locomotive is 235,000 pounds. This is said to be 35 per cent heavier than any freight locomotive yet used by the Lake Shore. The weight upon the drivers is 200,000 pounds. The tank capacity is 7,500 gallons and the coal capacity 16 tons. The boiler is built for a steam pressure of 200 pounds. The drivers of this big locomotive are 57 inches in diameter. The wheel base of the engine and tender is 58 feet.

AN AUTOMOBILE POLICE PATROL FOR CITY WORK.

When automobile police patrols come into use more generally the number of miscreants who suffer violence at the hands of mobs will be materially lessened. The fact that the automobile is dependent not on horseflesh, which is liable to give out, but on mechanism which is certain and can also attain a speed which would strike terror to the hearts of the average mob are two great elements in its favor.

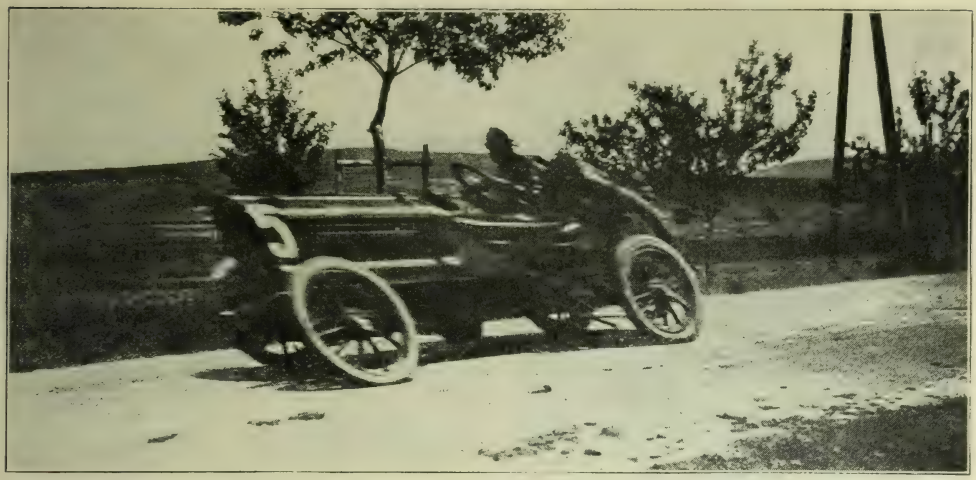
One of the foreign exhibits at the St Louis Exposition is an automobile designed for either police patrol work in cities or for a money or securities transport for banks and trust companies. The vehicle is very strong and has a powerful searchlight on the roof in front.



The Most Modern Pa'rol.

The leading cheese-makers of Wisconsin now dip the cheese after coming from the press, in hot parafine. This makes a coating impervious to air or moisture, hence a cheese so treated will keep longer and better.

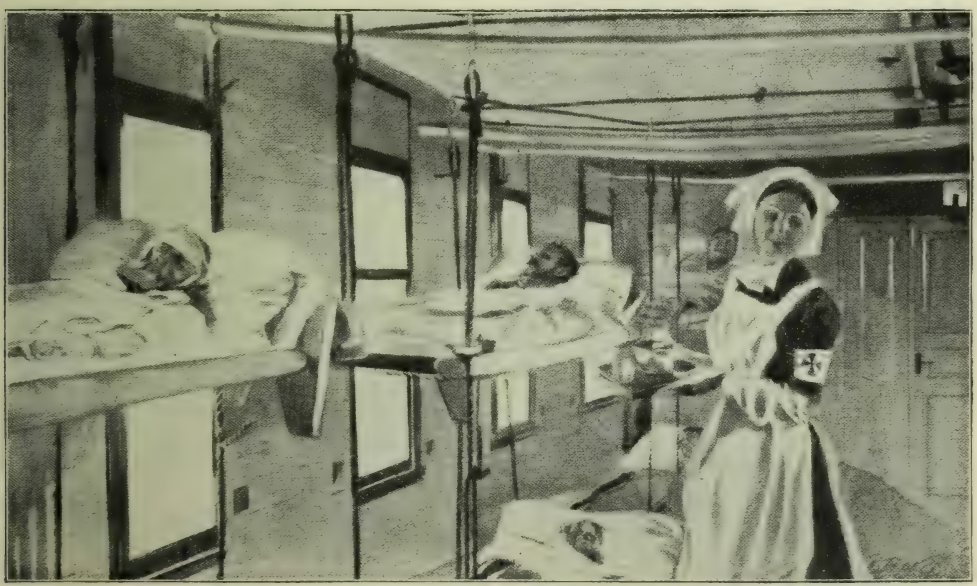
An Automobile at High Speed



An Instantaneous Photograph of Théry, the Winner in the International Gordon-Bennett Contest, Going at the Rate of 80 Miles an Hour. Exposure 1-1000 of a Second

---

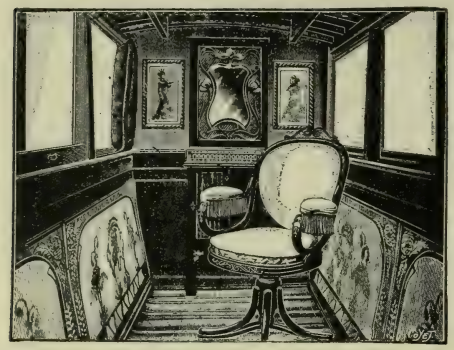
In the Russian Hospital Train at Mukden



The Red Cross Work is a Redeeming Feature of the War. To these Ministrant Spirits the Sick and Wounded of Both Sides will owe a Gigantic Debt of Gratitude. The Illustration Shows the Bare but Sanitary Interior of a Russian Hospital Train.

Royal Automobile for Emperor of China

The Emperor of China has joined the ranks of motor car enthusiasts, and has had built in France a royal car at a cost of $10,000. At first thought there seems nothing unusual in an Emperor having an automobile. But this Emperor is at the head



Interior of Chinese Emperor's Automobile

of the great Chinese Kingdom, and therein lies the wonder.

To appreciate the tremendous advance in western ideas by the ruler of the Orient, we need only to recall the stubborn resistance which for centuries, was waged against any of the barbarisms of civilization.

When the English laid the first railway in China there was great alarm among the natives who feared some evil spell, and when the first train went puffing and snorting over the new line there was general consternation on all sides. It is said the English locomotive engineers did not hesitate to make free use of their whistles, which were the special objects of terror.

And now the Emperor not only is to own an automobile but will go out to ride in one. Surely the world does move when the ruling fad in Europe and America receives Oriental recognition and patronage.

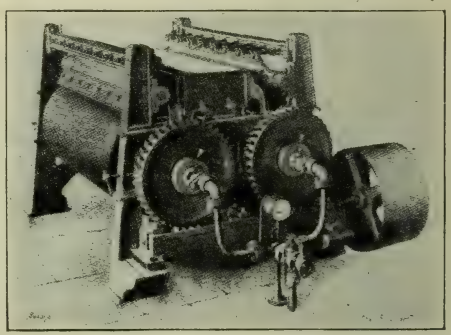
The Chinese Emperor's Automobile

The royal auto differs not so much from other motor vehicles, although it is handsomely furnished within and bears the royal insignia without. The Emperor is exclusive, however, and will ride alone, seated in a revolving chair. Guards will be stationed at front and rear to prevent any frisky little pig tails from "hitching on" and thus committing an act of lèse-majesté.

To the practical, every-day American, the royal auto carriage will appear very much as an ordinary good bus, such as he rides in to depots.

MACHINE FOR DRYING MILK.

A machine which dries milk and then grinds it into a fine white flour or powder is being used in England. The process is really very simple, consisting of two hollow cylinders heated by steam to a surface temperature of 230 degrees F., over which the milk passes. The cylinders turn in opposite directions. These cylinders are ⅛ inch apart



Milk Drying Machine

and the milk flows continuously upon them. The liquid portion is dried out leaving a dry substance like a sheet of paper adhering to each roll. A scraping knife is placed at the top which removes the product, leaving the cylinder clean to receive more milk. Only 30 seconds are required to convert milk by the quart into milk flour by the pound.

In some roundhouses pianos are used to test the engines. A pianist strikes the note with which the noise of vibration made by the locomotive part being tested should accord. A discord on the locomotive's part means a flaw.

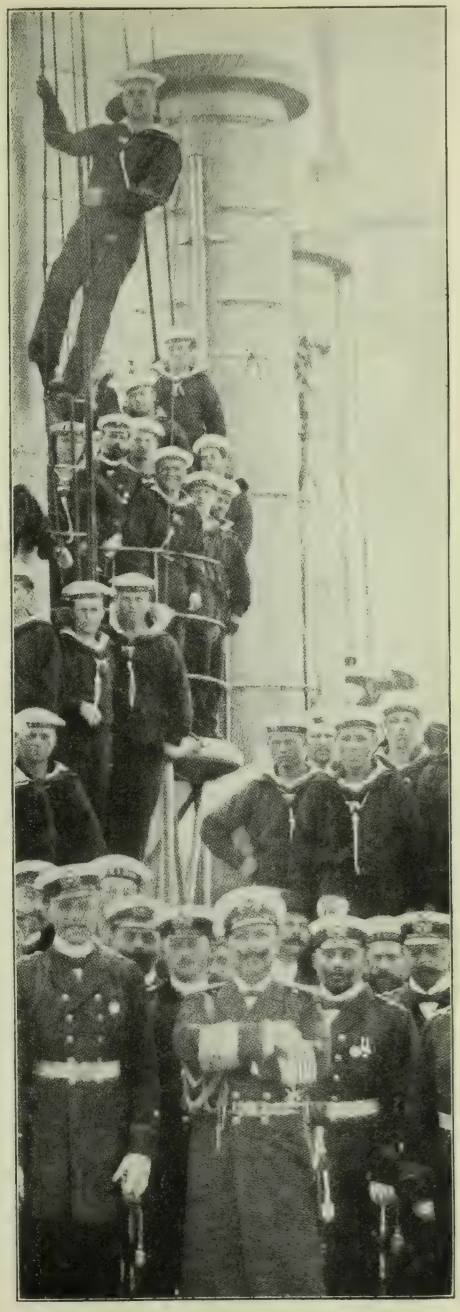
TROOPS BY TROLLEY.

In a country so large as ours, and in which the transportation lines are increasing so rapidly, constant vigilance is necessary at the War Department to keep posted on what facilities are really available.

"In a time of peace these precautions have only a secondary interest and value," says the Street Railway Journal, "but in time of war they are immediately necessary and there is no time in which to obtain them." It is urged that a complete knowledge of the transportation facilities now available on thousands of miles of interurban trolley lines should be mapped and recorded and the data made ready for use on a moment's notice. The same editorial further says: "In the Spanish war the transportation was a national disgrace. All accusations of pull and graft aside, it was the most stupidly organized and incompetently carried out attempt at mobilization that modern times has seen. The lack of full and exact knowledge of the railway facilities was at the bottom of the trouble. Some officer should have been able to drop in upon the manager of each railroad used with accurate previous knowledge of its entire capabilities upon which to base his plans. And for rapid concentration of troops this information must be extended to cover the electric roads as well as the steam roads. If it should be desirable to hurl a brigade suddenly upon some point upon the coast, some one should know not only what facilities can be secured to the nearest railroad station, but whether electric roads are available thence to the destination; how many cars can be concentrated at the given point ready for use, at what rate they can be dispatched without crippling the motive power, and at what speed the run can be made. If a dozen miles is to be covered it may make a vital difference in the result if electrics can be used. In a country well covered by electric roads infantry can be given almost the mobility of cavalry, if the roads can be utilized at short notice; but practical usefulness depends upon good previous knowledge of their exact capabilities."

The Dead Sea has 26 per cent of solids consisting principally of chlorides of sodium, magnesium and calcium. Its greatest depth (1,310 feet) is 2,600 feet below sea level. The sea has its own cloud system, and its clouds frequently hang six or seven hundred feet below the ocean.

Emperor William



The Kaiser on a Warship at Kiel, "the Cradle of the German Navy"

A Good Method For Printing Postcards

For printing postcards, which any photographer can make a profitable side line, the collotype method is the best, for by it hundreds of beautiful prints can be made cheaper than tens by any other process, and the method is very simple.

An expensive press for this work is not necessary. An ordinary letter-copying press will do very good work, several patterns of printing-presses may be readily adapted, while an excellent collotype press, taking a 10x7¼, may be obtained for about $35. The drying oven for the plates, although a great advantage, is not absolutely indispensable; a very good substitute may be quickly made with a suitably perforated wooden box, provided with a metal shelf for the sand-bath, properly leveled ledges for the plates, and a couple of long atmospheric gas burners connected with a rubber tube for heating. The box is open at the top, and covered during use with a canvas lid to allow of free ventilation. The preparation of the glass plates presents little difficulty to a careful worker. Glasses of suitable size are obtainable of any dealer in photo-mechanical goods. It is advisable at first to buy them ready ground; when a little experience has been gained they may be ground as wanted by placing the finest emery powder between the glasses, well wetting with water, and rubbing them over each other till both are sufficiently ground; they are then well washed and dried. Before they can be sensitized apply to the glass the following solution: Albumen, 5 ounces; potassium silicate, 2 ounces; water, 5 ounces. This should be well mixed and filtered, and poured over the plate in much the same way as a varnish. The plate is then placed in a rack to dry; when dry it is rinsed under the tap and again dried. A suitable formula for sensitizing is Creutz middle hard gelatine, 1 ounce; potassium bichromate, 50 grains; ammonia bichromate, 20 grains; chrome alum, 1 grain; water, 10 ounces. The water is divided into two portions, the gelatine being placed in one and the bichromates and chrome alum in the other. As soon as the gelatine has absorbed the water it is melted by a gentle heat and the bichromate solution added gradually, stirring well. The solution is then filtered through swansdown, calico, or wash-leather before it has time to get cool. For this purpose a filter pump or similar device is very useful. When filtered the solution is ready for application to the plates, which should be first warmed. The liquid is poured on similarly to a varnish, helping it where desirable with a clean glass rod. It is now placed to dry on a perfectly level shelf or slab in the drying oven for about two hours, the most suitable temperature being about 120 degrees Fahr. Draughts and vibration should be carefully avoided during the drying. The plates should dry evenly, absolutely free from streaks, and with a dull matt surface. They are then ready for exposure. A printing frame with wedges or screws is preferable, but for postcard work not absolutely necessary so long as close pressure and contact can be insured. The most suitable negative is one that is soft, with ample gradation and detail; hard negatives are quite useless if the best results are desired. The edges of the negative are masked by gumming on narrow strips of tinfoil to the desired shape. Printing is judged by looking at the back of the plate; a faint brown image is visible, and detail should be perceptible in the high lights. Those who prefer it may work with an actinometer after one or two preliminary experiments. Development is effected by washing with cold water until the bichromate is completely removed; this will take about an hour and a half to two hours. The image will be invisible, but will perhaps show a slight amount of relief. The plate is then stood up to dry. Before it can be printed from it must be treated with what is known as "the etch," a solution intended to be thoroughly damp and keep it in a moist condition. A good formula for this is water, 10 ounces; glycerine, 15 ounces; sodium chloride, 25 grains. The plate is leveled and the solution poured over, allowing it to remain for from a quarter of an hour to three hours, according to the hardness or softness of the plate, a factor which naturally depends on the exposure given. An over-exposed plate will need to remain longer under the solution than a normally exposed one. It is better to give, say, half an hour first, then to wipe off the solution with a sponge, and gently dry the plate with a clean rag. The plate can now be placed in the press, inked, and an impression pulled, when, if unsatisfactory, the ink may be removed with turpentine and a further etch given.

An ink slab, a small quantity of thick collotype ink, a fine nap roller, and a composition or gelatine roller are now required. For the ink slab an old lithographic stone may be used, on which the thick ink is to be worked up with a little collotype varnish and a palette knife. The ink should be used as stiff as possible, and is applied to the plate with a nap roller, a fair amount of pressure being used and the work being done rather slowly until the plate appears black all over. The latter is now rolled with the composition roller, more rapidly and with less pressure. This will clean the picture up a good deal, and several proofs can now be taken, when it will be seen whether the plate requires re-etching or other treatment. The margins may be cleaned, if necessary, with a strong solution of hypo or by masking the edges with strips of oiled paper. Care must be taken that the plate is well cleaned at the back before placing in the press, as the slightest grit or inequality will cause it to crack under pressure. It must be accurately leveled, and laid on about half a dozen sheets of thick blotting-paper as a bedding, after which proceed with the printing.

There are, it should be mentioned, one or two even simpler modifications of collotype, in which the necessity for a glass plate is done away with; these are peculiarly adapted for postcard work, where very large numbers of prints from one negative are not desired. The photographic worker who makes a chronic complaint of "bad business" is strongly urged to make a trial of the many possibilities of collotype, not only for postcard work, but for the numerous other purposes which will readily suggest themselves, not the least of which is the rapid completion of orders in dull weather, when one is often at a loss for useful and profitable occupation.

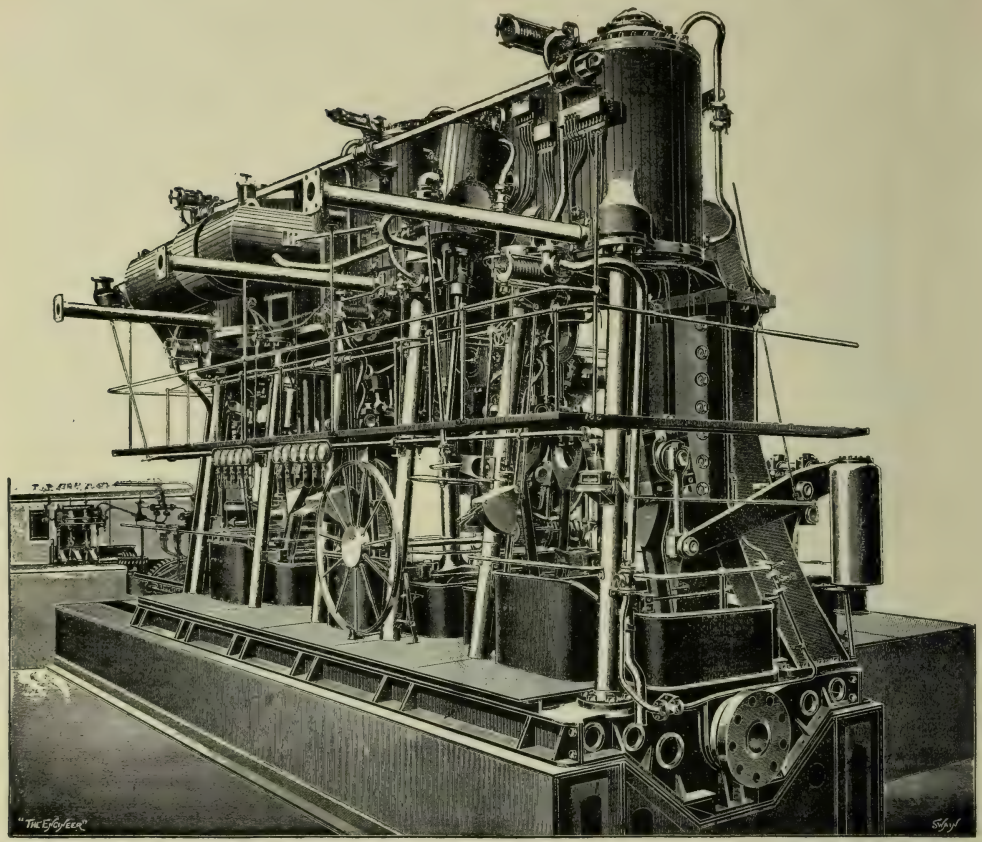
How the Chinese Catch Tigers

An Ingenious Method of Trapping Tigers

The natives of a wild and isolated part of Cochin China construct an ingenious trap for catching tigers and large black panthers which abound in the district. A short length of a tree log is hollowed out and around each end of it are driven long, sharp spikes, so as to project inwards, leaving an opening of about six inches. Through a small trap door a pariah dog or a pig is then placed in the log for bait and the trap left for future developments.

The tiger or panther easily pushes in his paw to secure the bait, but when he tries to withdraw it, it is impaled on the sharp spikes and he is trapped. Not infrequently tigers carry off natives or stock, though all the villages are surrounded by strong palisades.

Powerful Marine Engines



7,500-I. H. P. Triple-Expansion Engines in H. M. S. "Prince of Wales"

The new first-class battleship H. M. S. "Prince of Wales," is driven by a pair of engines aggregating 15,000 horsepower. Each unit is 7,500 horsepower and contained in a separate watertight compartment. There are really three engines in each of the two sets, working together as triple-expansion, by means of which the same steam is used three times. From the boilers the steam enters the first or high pressure cylinder (diameter 31½ inches) at 250 pounds pressure; thence it passes to the intermediate pressure cylinder (diameter 51½ inches); and then to the low pressure cylinder (diameter 84 inches.) The steam is then exhausted into condensers with a total cooling surface of 16,000 square feet.

The illustration shows one of the triple expansion sets. Twenty large boilers are required to make steam for these engines, and afford a heating surface of 37,640 square feet. The grate surface in which the fuel is burned has an area of 1,170 square feet. A better conception of this roaring, furious mass of flame is to think of it as 117 feet long and 10 feet wide.

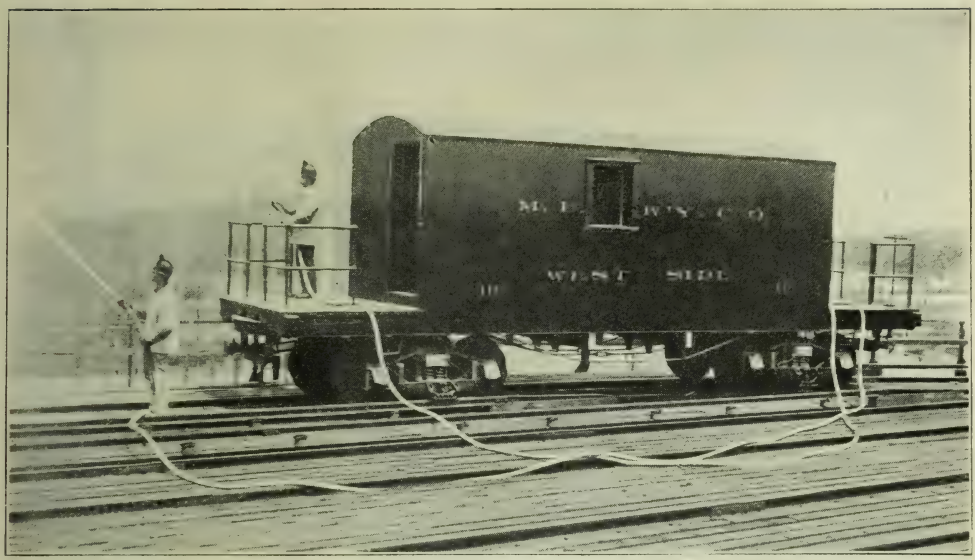
The engines were built in England, and at the recent test went considerably in excess of their indicated power.

London bridge has recently been widened from 53 feet 5 inches to 65 feet, at a cost of $3,500 per running inch. This makes the roadway over the bridge 35 feet wide and the foot walks on either side 15 feet wide.

The Wabash river is one of the best pearling streams in the United States. One man who engaged in pearl hunting last year secured $5,000 worth of pearls, the finest being worth $80. The hunting is done when the river is low.

Fire Engines in The Air

How An Elevated Railway Fights Its Fires



Fire Engine Car for Elevated Road

Fighting fires at terminals of elevated roads occasions great difficulty for the firemen, not only because the structure is a good many feet above the surface of the earth, but the particular part or car where the blaze has originated may be in the center of the yard, surrounded by many cars and, worse by far, by a maze of highly charged rails, to come in contact with which would be dangerous, not to say fatal. Under these conditions the problem of leading the hose to the right location is a troublesome one.

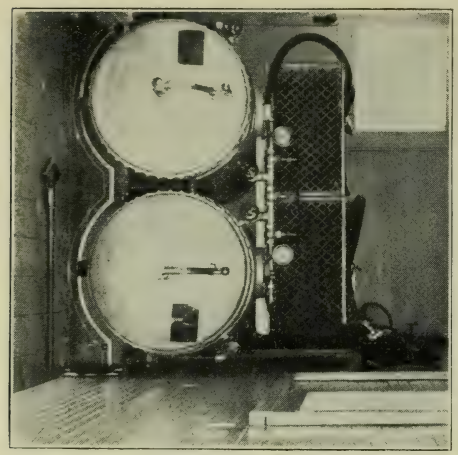
The Metropolitan Elevated Railway Company of Chicago has recently installed a new fire car for the protection of its four yards and terminals where it has many cars stored. The fire car is 8 feet wide and 30 feet long on the outside, including a 5-foot platform at each end. The house of the car is 20 feet long, has two windows and two doors, and is completely covered with corrugated iron. The platforms are of ¼-inch steel plate.

The fire extinguisher system consists of two duplicate horizontal pressure tanks mounted side by side on the floor, leaving a 3-foot passage at one side of them. A shaft runs through the center of each tank and each shaft carries two paddles and terminates on the outside of the tank, one end of each having a crank. In the top of each tank near the crank is a large hole closed by a cap which screws down closely, and inside the tank under the hole the shaft and paddles are bent so as to form a cradle. Water and soda are put in through the holes, mixed by a few turns of the paddles and then the acid jar is set in the cradle and the shaft rotated, spilling out the acid and agitating the whole mixture so that the pressure is maintained. A hose basket on top of each tank holds 150 feet of 1-inch hose, coupled at one end to the piping out of the pressure tanks and having at the other end a ½-inch brass nozzle with a shut-off valve. Either hose or both hose together can be played from either tank and a 250-pound pressure gage is mounted on each hose near its controlling valve.

An upright water supply tank of 250 gallons capacity stands in the opposite corner of the car, at a height which allows the water to gravitate to the pressure tanks. Under the water tank is a cupboard for storing charges of soda, etc.

To put the apparatus into action all that is necessary is to lead out the hose, turn the crank a few times and open the proper valves. One tank is discharged at a time

and is refilled while the next one is being used. One tank, supplying both hose lines at 150 pounds pressure, will run 7 minutes, and it takes but 4 minutes to recharge it.



The Chemical Tanks

The car has no motor but is so located at the yard that any motor can move it. The company are building three more of these cars so that there will be one at each of its terminals.

Aluminum bobbins are to be used in the textile industries hereafter, instead of wooden ones. Wooden bobbins suffer from variations of temperature and at times revolve so irregularly that they cause the thread to break. Aluminum bobbins revolve in any temperature and at a greater speed than the wooden ones and are also much lighter.

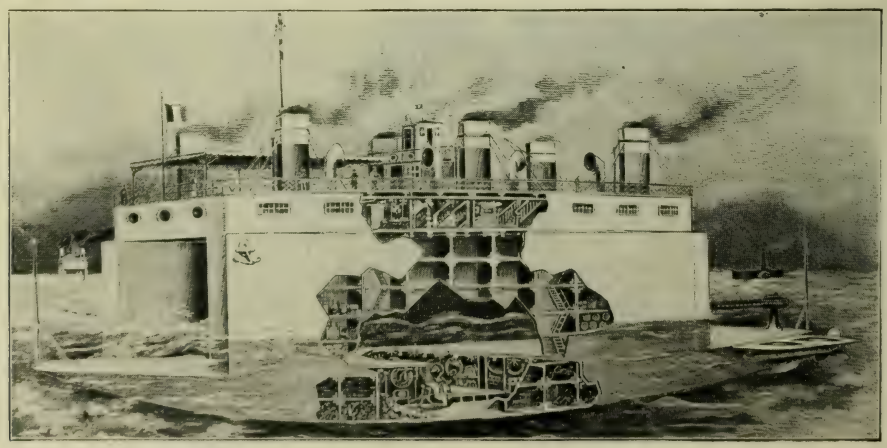
RIDES ROUGH SEAS IN COMFORT.

Strange Craft for Use in the English Channel

French shipbuilders are determined to produce a craft which shall sail the turbulent waters of the English channel in peace and comfort. This water gap between England and France is the pathway of a constant train of passenger vessels which are tossed about unmercifully by the conflicting powers of currents, tides and winds; when all three combine, even the bravest sailor would rather be on shore.

A few years ago the French built a vessel in which the upper works rested on two hulls like a great catamaran. It failed, however, as the center of gravity was too high. Another effort is being made in which the hull is submerged and the upper works rest on two longitudinal sides, permitting a free wash of the sea through the aperture thus created. All the fuel, boilers and engines are in the hold, and water ballast tanks further serve to hold the vessel down in the water. The cabins and staterooms, which are comparatively light, are all at the top. The entire structure is of steel, with heavy skeleton framing like a modern skyscraper. Four batteries of boilers furnish steam to the 16,000-horsepower engines which will propel the boat at a speed of 19 knots per hour. It is expected the most sensitive person will be able to make the crossing without any suggestion of sea-sickness.

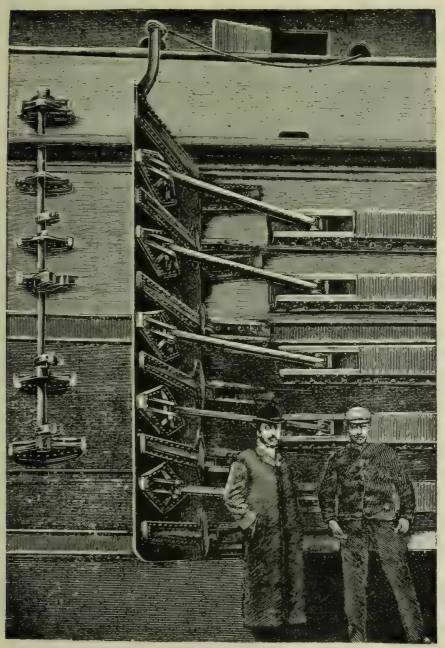
The construction of whaleback vessels overcomes the rolling and pitching somewhat, but there is room for much improvement in this line.



Ship to Sail Smoothly in Rough Water

BRAKES TO STOP SHIPS.

A brake for ships has been invented which greatly assists in overcoming the momentum of the vessel. The present method of stopping a boat is by reversing the engines and propellers. This takes time, and in the case of a large craft, it must



Huge Brake for Stopping Ships.

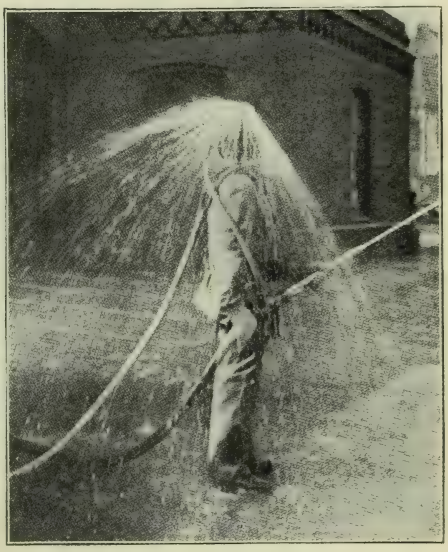
proceed a considerable distance before the retarding influence begins to take effect. While this time is being lost a collision may have occurred.

The ship's brake is a strong steel plate, in size proportionate to that of the vessel, which, when released, unfolds from the hull and assumes a position at a right angle. Strong steel arms hold it in position. When not in use the brake folds up close to the hull and is held in place by a set of dogs acting as clamps. With a number of these brakes on each side of the hull, and placed of course, below the water line, the effect is felt at once when they are released. The brakes are all controlled from the pilot house and bridge where the movement of a single lever instantly puts them all in action.

During a recent trial made in the St. Lawrence river, near Montreal, a steamer was driven ahead at an indicated speed of eleven knots an hour. Steam was then shut off, and simultaneously the brake on each side opened. The vessel came to a full stop within a distance equal to her own length. The brakes were then closed, the vessel sent ahead until the original rate of speed was attained, when the engines were reversed and the brakes opened, with the result that all headway ceased after she had gone but 50 feet—about half her length. In maneuvering the "Eureka" at full speed she was turned also within her own length, with one brake thrown open. An examination of the hull and brake mechanism after the tests showed apparently no harmful strain or other damage, and in operating the brake, no jar or vibration was observable by those on board.

SMOKE RESPIRATORS FOR FIREMEN.

Smoke respirators are now used by many fire brigades in all countries. With the spray of water falling around his head the fireman's eyes, nostrils and mouth are well



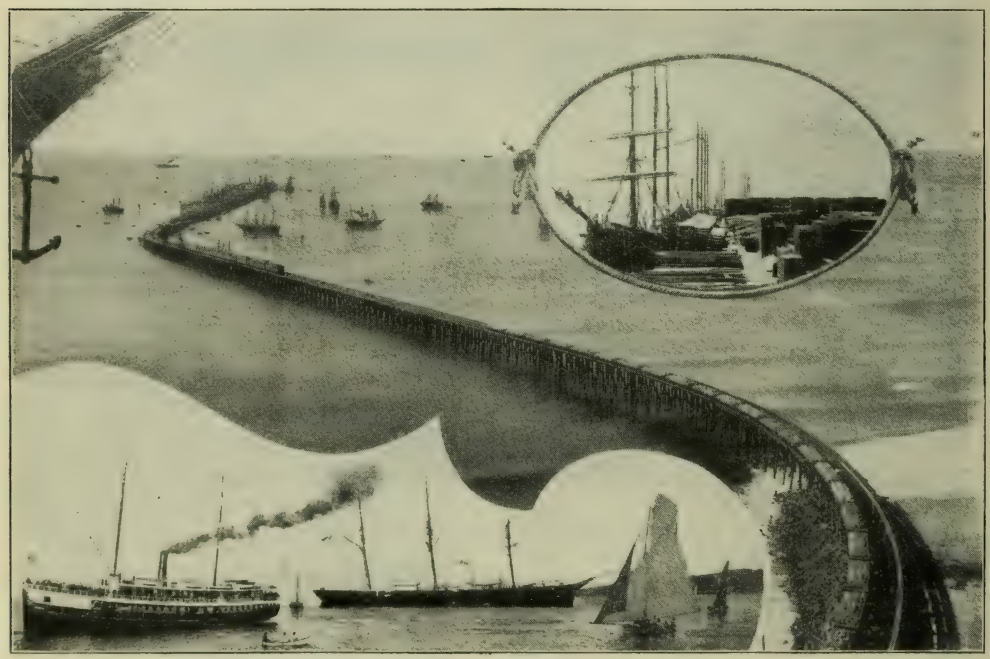
Smoke Respirator in Use

protected from the heat, and he can remain a long while in rooms and other places highly charged with smoke, fighting the fire and saving much valuable property.

"Telagirl" is the newest use for the telephone. It is simply dictating to a stenographer over a telephone. The stenographer then typewrites the matter and it is then sent to the office of the dictator.

LONGEST WHARF IN THE UNITED STATES.

What is without doubt the longest ocean-wharf in the United States, if not in the world, is in the state of California. This great railway dock is located at Port Los Angeles, which runs out into the sea from the mouth of the Canyon two miles north of Santa Monica, California. The structure is over 4,700 feet long, and the claim is made that it is the longest wharf in the world. It is built on wooden piles, set in rows 12 feet apart. The piles are of fir and pine, and 5,000 trees were cut down to secure the material. The structure cost



Ocean Wharf 4,700 Feet Long

$500,000. A double track extends the entire length with switch tracks at the sea end where vessels from all parts of the world transfer freight to the steam roads. The outer portion of the pier is supported on concrete piling, and includes offices, shops, coaling bunkers, etc. The freight and passenger traffic handled is very large.

The laundry bill of a line having nine passenger steamers amounts to $20,000 a year. A stock of 25,000 pieces of washable goods is required and the work of examining and repairing it at regular intervals costs about $6,000.

DEVICE PREVENTS OIL OR GASOLINE EXPLOSIONS.

The "Nonex" is a new device which under severe tests prevented the explosion of gasoline, reports U. S. Consul Halstead, of Birmingham, England.

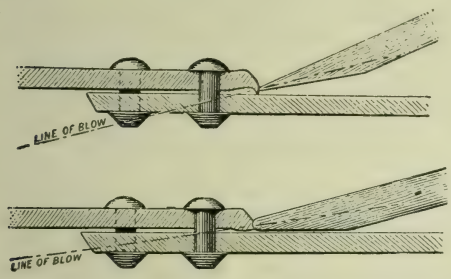
The device consists of a tube made of layers of metal, each layer perforated to allow the liquid to be poured out when desired. The tube is fastened to the opening of the tank or vessel and projects inward to the bottom where it is closed. When the tank containing the liquid is exposed to heat or directly to flames the solder holding the fusible screw cap melts, leaving the perforated tube open. The gas percolating through the tube burns, but no explosion follows, nor does the oil in the tank catch fire for the metal layers of the tube absorb the heat which otherwise would expand the liquid and cause an explosion.

A 20-gallon tank partly filled with gasoline and fitted with a tube was placed on a lighted bonfire and did not explode. The fire inside the tube was easily extinguished. The weak point is how hot can the tube become without expanding the gasoline? The inventors have never made a test long enough to show this.

SHOP NOTES

CAULKING BOILERS

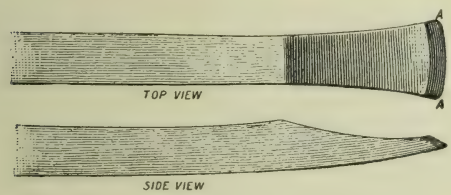
Caulking a steam boiler is something which requires more skill and experience than many engineers and mechanics realize. A correspondent in the Blacksmith and Wheelwright contributes the following comments:



First method, improper; second method, good.

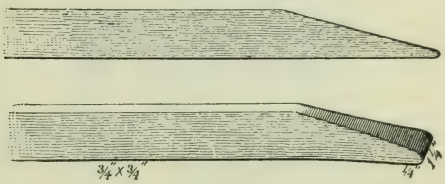
I worked for an iron ship-building concern employing three thousand men, and saw most kinds of work done, though not perhaps working at it.

In first-class boiler work the edges of the sheets are all planed slightly beveling, as it makes a better joint to caulk; too much lap outside the line of rivet holes being as bad as too little. I fancy the allowance is 1½ diameter of rivet, but forget whether taken from center hole or outside edge—nothing is used between edges. If the edge of the plate is not planed or is rough, it has to be chipped and great care has to be



Caulking Tool.

taken that in doing so a line is not cut along the joint on the other plate, weakening it and inducing grooving. Many cases of explosions have been traced to this cause, the rip having followed the caulking line instead of the rivet line. What has to be aimed at to make good work is expanding or upsetting the plate enough to make a tight joint, such upsetting to go some distance down, not merely a little burr. To do this you want a round-nosed tool, held well upright, held hard to its work and struck with not too light a hammer, and the chisel not so long it takes up the blow; leave no gaps—marry your work as you go. Avoid using too thin a pointed chisel, which is



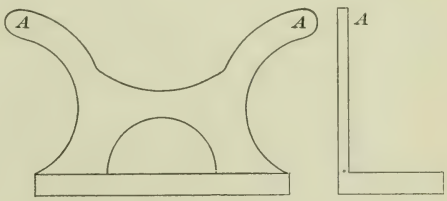
Caulking Chisel.

likely to open up a strained seam or at best only to force off the top edge and make a burr and rust joint.

This is not to be taken as favoring heavy caulking, which is as bad as drifting holes, but let us use what brains we have. Well done is twice done, and men's lives are back of our work and we are responsible for them.

VISE JAWS CAST FROM SOFT BRASS.

Many big machine shops use vise jaws cast, as here shown, from soft brass. A is

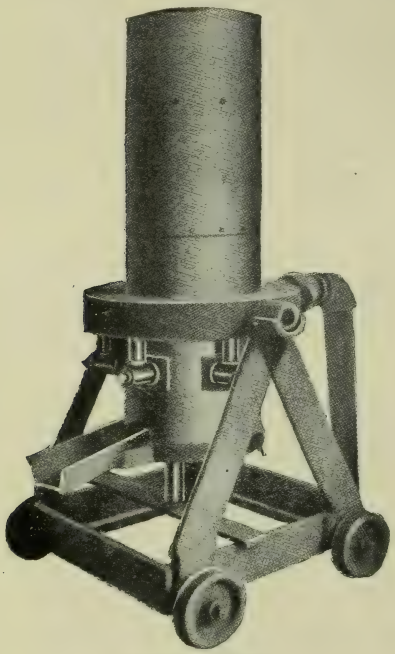


formed over the top to keep from falling off.

Those of our readers who are specially interested in this department are invited to send in new ideas and "kinks", which are likely to be of interest and help to others.

HOW TO MAKE A PORTABLE CUPOLA.

All foundries have to produce castings in a hurry at times, and sometimes it is inconvenient to wait for iron from the regular cupola or to fire up one of the large cupolas for a small quantity of metal, says Foundry.



A Portable Cupola.

A small portable cupola, such as that shown in the accompanying illustration, will be found very serviceable indeed for such occasions as this. The cupola shown is in use in Paducah, Ky. It has no stack and is set against one wall of the foundry. Air for the blast comes from the blacksmith shop, which is about 20 feet away, the air being conducted through a pipe underground and brought up behind the cupola, as shown. Connection is made with the cupola by means of a gland, as shown in the illustration. The diameter of the shell is 18 inches and the height of the shell 5 feet. All of the castings for the cupola were made in open sand, and the construction was such that very little patternmaking was required.

The bussel pipe is a ring of square cross section, about 5 inches on a side. The tuyeres are made from 1½-inch pipe. The cupola is mounted upon a frame upon wheels, as shown, so that it can be moved away from the wall for cleaning and repairs. The A-shaped frame which supports the trunnion is 3 feet high, the center of the trunnion about 3 feet 6 inches from the floor.

When in use the cupola is lined with molding sand ¾ of an inch thick. A casting weighing 300 pounds can be made with this cupola, and a heat of 700 pounds of metal can be taken from it. The charges for such a heat are as follows: Three riddles of coke for the bed and 300 pounds of iron. This is followed by two charges composed of one riddle full of coke and 150 pounds of iron each, and one charge of one riddle of coke and 100 pounds of iron.

The cupola can be gotten ready and hot iron available in from an hour to an hour and a half at any time. When large brass castings are required, the cupola is simply relined and from 300 to 400 pounds of brass melted in it without any difficulty.

DETERIORATION IN GRATES.

The principal cause which contributes to the rapid burning out of the grate bars in a boiler is the action of the furnace heat, which will in time destroy any set of grates, but the want of a proper flow of air through the grates will cause overheating, whether it occurs through too little air-space in the grates themselves, or by these spaces becoming obstructed through any cause, thus preventing the cooling effect of the air on its passage to the fire. Another reason is found in the impurities of the coal, and especially in the chemical combinations of sulphur and iron, which impurities are found in more or less quantity in all coals. The Practical Engineer says any coal which forms an easily fused clinker will injuriously affect the grates.

TEMPERING TOOLS

Heat the tool to blood red and quench in a mixture of 1 ounce of white arsenic, 1 ounce spirits of salts, 1 ounce sal. ammoniac, dissolved in 4 gallons of spring water. Draw gently over clean fire until spittle flashes off, then let it cool. Keep the mixture in an iron receptacle for use.

HOW TO PAINT A CANVAS TOP.

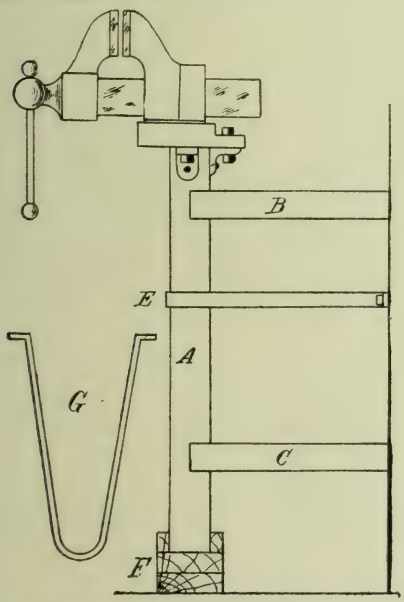
Wet the top thoroughly, using a sponge filled with water and letting the canvas have all it will hold; then apply the paint. Two coats applied in this way will not strike through and will remain in good condition for years.

COPPERING STEEL.

In preparing copperas for steel a few drops of acid (muriatic) will make the solution adhere to oily metal and can be used immediately without waiting for it to dry. Just coat the piece to be coppered and wipe off the remaining moisture with a piece of waste or cloth. To coat brass or bronze with this solution take a bit of waste dampened, and dip it in cast iron dust, then apply to pieces you wish to coat. This gives a fine coppered surface and any lines will show very plain.—W. F. S.

A CONVENIENT VISE ARRANGEMENT FOR FILING.

Having a great deal of filing to do, I built a vise as follows, the letters referring to the figure herewith, says a writer in the American Blacksmith. At A is shown a piece of 3-inch pipe, having three angle lugs riveted to the top with holes to correspond with the holes in the vise. B is the bench, having a half circle cut out of its face to receive the pipe. C is a shelf cut out in the same manner as the bench, and D is a

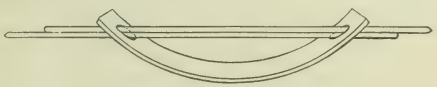


DEVICE FOR CONVENIENT FILING.

piece of 1¼ by ⅜-inch tire bent as shown at G, and bolted to the wall so that the pipe is free to slide up and down or turn at any angle to get better light. A blow downwards at E fastens the vise in any position or at any height desired, and a slight tap upwards loosens it. F is a block having three different thicknesses, the middle thickness being the one I ordinarily use for convenience. Ever since finished, my satisfaction with it could not be expressed in words.

HANDY INSIDE CALIPERS.

A pair of inside calipers can be made from a scrap of sheet steel, spring or tempered steel is the best, or from an old hacksaw blade. Enlarge or make a hole in each end which will allow two rods ⅛ inch in diameter to pass through. The pressure



Handy Inside Calipers

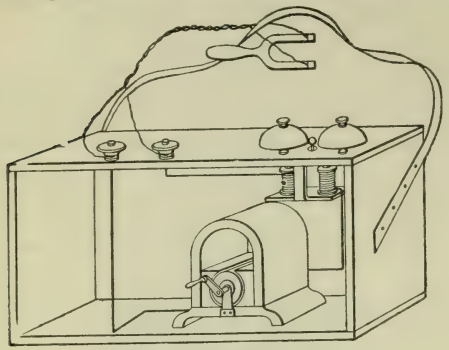
on the rods caused by the spring will be sufficient to hold them firm and they can be adjusted to any inside diameter and the distance measured while they are still in place by a rule, or better still, the rods can have inch marks filed on them.

TO TIGHTEN BABBITT IN A JOURNAL BOX.

Not long ago there was an inquiry as to the best method for tightening babbitt in a journal box. There have been ways and means exploited of doing such work, says the Wood-Worker, but the best way of all is to run a new box, and have the box hot when the metal is poured. To do a job of babbitting and have it theoretically and practically correct, would call for having the box as hot as the metal, so that both might cool and shrink together. That, we know, is out of the question in ordinary practice, but by keeping this fact in mind we are encouraged to have the box as hot as possible when the metal is poured; while, if we do not keep it in mind, we shirk the task of warming the box, till it gets warm weather, and then we only make a bluff at it. This does very well, too, on ordinary shafting, but when we come to machines that run at high speed and tension, the best is none too good, even when its application is to as small a thing as putting metal in a box. Especially should operators of planers take this hint, for while it may worry them temporarily to heat the box hot for running, it will save the chance of enough future worry to pay for it.

QUICK AND EASY METHOD OF TESTING INCANDESCENT LIGHTS.

A convenient testing outfit is made of a generator, a bell from an old telephone box and a wooden fork with metal tips, says a correspondent of The Engineer. The tips of



For Testing Incandescent Lamps

the fork are far enough apart to rest on the binding screws of the rosette and are the terminals of the circuit containing the generator and the bells. Upon turning the generator crank while the fork tips are in contact with the rosette binding screws, the ringing of the bells shows that the lamp and cord being tested are in good order. Always open the switch or remove one of the other lamps before beginning testing.

PLASTER AS A FLUX FOR BRASS.

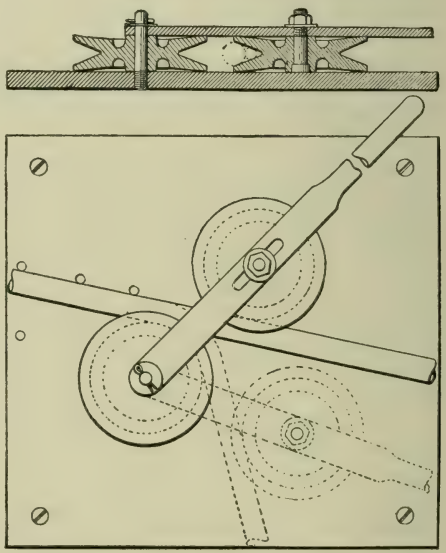
Plaster of paris as a brass foundry flux is strongly recommended by writers on foundry topics, especially where washings, screenings or grindings are to be melted. The method recommended for using plaster of paris for flux in this work is as follows:

Add four or five pounds to 100 pounds of metal, either before the crucible is put into the fire or after it has been in for some time. It is better, however, to have all the flux in the crucible before the metal begins to melt. If possible, it is conducive to better results if the plaster of paris is mixed with the metal and the whole added to the crucible at the same time. Such a procedure insures a more intimate contact with each particle of metal. One need not have any fears about getting a little more than is necessary, as no harm follows, and the flux may be used over again. When the metal is melted and the mass has arrived at a state of complete fluidity, the crucible may be removed from the fire, and the whole mass, flux and all, poured into the ingot moulds. The flux rises to the top, and when cool everything leaves the mould in an excellent manner. Of course the slag may be skimmed off if desired, but as it is usually difficult to completely remove the liquid mass, the former procedure is advocated. The flux does not adhere firmly to the metal, but a few light blows from a hammer always remove it. The flux may be used over several times. So far as the writer's experience has gone, there appears to be no action on the crucible, a feature of the utmost economic importance.

DEVICE FOR BENDING PIPE.

For bending pipe without flattening it the device here shown is one of the best, says a correspondent of The Engineer.

The wheels are made of cast steel and bear on the pipe, top and bottom, thus keeping it from flattening. By this means 1-inch



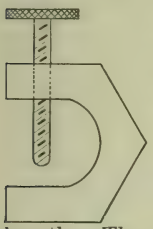
Bending Pipe Without Flattening It

pipe has been bent to a radius of 5 inches and by a little practice it is possible to bend ½ to 1½-inch pipe to almost any shape.

French morocco which is stamped with stylish designs and sold at a high price in the shape of wall paper, trunk coverings and other articles, is made of old shoes collected in France and sold to factories where they go through a number of processes and come out in the form of paste which is transformed into imitation leather.

A PAIR OF HOME-MADE CLAMPS.

A pair of clamps for small work, for which large clamps would only be in the way, can be made of an old hexagon nut and a bolt.



Cut off two adjoining sides of the nut, as shown in the illustration, leaving that side open. Bore a hole in the middle of one of the edges next the opening, the size of the hole depending on the size of the nut, and screw in a bolt of the proper size and length. The bolt is screwed in contact with the article placed in the clamps. W. K. Smith, of Baltimore, sends us the suggestion.

HOW TO MAKE PAINT ADHERE TO ZINC.

One of our readers, John M. Blake, sends the following:

Some time ago the writer was constructing a piece of apparatus, in which metal zinc was to be the support of a slate surface. This surface was to be made by applying a paint composed of shellac in alcohol, containing pumice stone and lampblack. Just as the affair approached completion, an all-around mechanic, who had become interested, said: "The thing will not work. You cannot make paint stick to zinc."

This remark caused a study of the subject to be in order, and the following experiment was made by the writer:

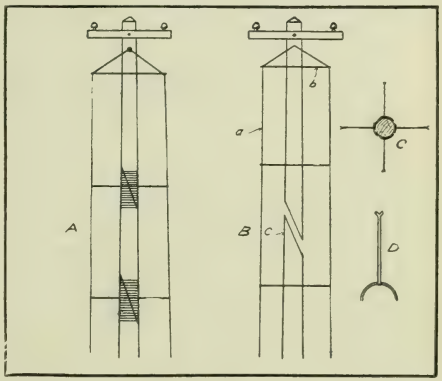
A portion of the "paint" was diluted with alcohol, and the surface of the zinc was well sandpapered while thoroughly wet with the solution—the intention being not to allow any part of the surface to come to the air during, or after the operation of sandpapering. The paint was thick enough to cover securely as it dried. When every part had been gone over carefully, a number of coats were added so as to fill up low places, and the surface was ground with pumice stone.

Time has proved the success of this experiment. Many years have gone by, but the coating holds perfectly, and the matter is now brought forward with the hope that the suggestion may have useful application in ordinary painting. For instance, signs painted upon sheet zinc, clock faces, and perhaps other articles.

The theory upon which this experiment was based is that zinc oxidizes instantly, wherever a fresh surface is exposed to the air. This oxide is so white and thin that it is not visible. Nevertheless, it is present, and forms an unstable attachment for the paint as commonly applied, thus preventing the same from coming in absolute contact with the metal itself. The sandpapering operation under cover of the wet paint, produces a different condition of things.

HOW TO LENGTHEN POLES.

In places on telephone routes where an unusually long pole is needed it is not always necessary to waste time and money in securing one, says the American Telephone Journal. Instead, two or three poles may



Lengthening Poles

be spliced together in the following manner and will be found very strong:

The ends to be spliced together are shaped as at c. They are then tightly bound with wire. At the top of the pole a bolt is driven through and to this four steel wires (a) are attached which are separated by means of spreaders, as shown in Fig. C. Fig. D illustrates the sort of spreader to use. These wires should be brought down to the base of the pole and fastened in a similar manner to that employed at the top. When well done the pole will be as staunch as if it were made of a singe piece of wood. The Fig. A illustrates the use of three poles to secure one long one. The tension wires should be grounded so as to prevent injury from lightning.

HOW TO MAKE A RUST JOINT.

Mix 10 parts iron filings and 3 parts chloride of lime to a paste by means of water. Apply to the joint and clamp up. It will be solid in 12 hours.

PRACTICAL CONDUITS FOR STEAM PIPE.

The best conduit for underground steam pipe is a wooden box large enough to leave two inches of space all around the pipe, says Power. When the pipe has been properly tested and made tight fill the space around it with mineral wool, being careful to keep the wool away from the eyes and any cuts or sores on the hands. Do not use wool made from blast furnace slag, as the acid it contains injures the pipe. The best is made from rock. Be sure the box is full

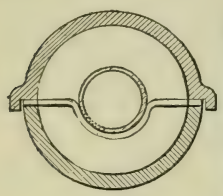


FIG. 2

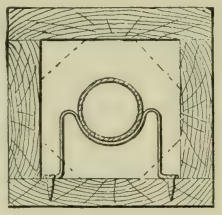


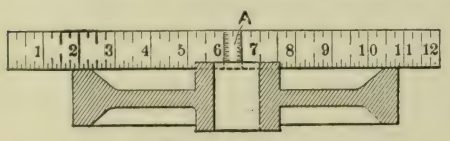
FIG. 1

but do not pack the wool. If the wool is very expensive the corners of the box may be filled as shown in Fig. 1 and the amount needed cut down somewhat. Fasten the cover down with brass screws so that it may be readily removed.

For underground piping in boiler rooms and for long lines of pipe where a permanent conduit is needed Fig. 2 shows an excellent method. It is made of special vitrified tile, like a sewer pipe, split longitudinally with ball and socket joints which may be made up with cement for the bottom half. Leave a joint free every 8 or 10 feet to drain off water. Under either of these conduits place several inches of broken stone to provide for drainage.

AN IMPROVEMENT IN SCALES.

A scale having one or more cross scales marked on vertical lines near its center (A) has recently been patented, says The Patternmaker and will be found useful to the



A Handy Scale

mechanic for many purposes. By laying the scale across the rim of a gear or pulley the height of the hub can be measured on this cross scale.

HOW TO MAKE KNOTS AND HITCHES.

Every machinist and mechanic should be an expert in making knots and hitches. The time lost in fussing with a rope or chain where the workmen do not know what kind of a hitch to use nor how to tie it, amounts to many dollars during the year. Then there is the always present danger of damage to the piece hoisted, and injury to the men engaged in the work, where hoisting is carelessly done. One of the best articles on this subject that has appeared in a long time we extract from the American Machinist. The directions and illustrations are so simple and plain anyone can learn the trick by experimenting with a piece of soft rope. The writer, who is evidently an expert, says:

Fig. 1, made by two endless slings and used as shown in Fig. 2, is a reliable basket hitch when both slings are of equal length, or with one sling long enough to take in one-half of the cylinder's diameter and the other to run through both loops of the smaller and have its own loops catch the chain hook.

Some people hoist a shaft endwise by using a collar or lathe-dog as a safety stay; others use the bitting-rolling hitch shown in Fig. 3, but in one conservative concern whose screw and bolt department, on the fifth floor, is provided with an independent hoist chain, they use the rig shown in Fig. 4. The bucket is hoisted above the floor level and then pulled in as the hoistway is reversed and made to lower away.

It is a very common practice, in the absence of a ready-made endless sling, to tie a flat knot in a short length of rope and use it in lieu of a sling. Be careful to avoid a "granny knot," Fig. 5, which is unsafe and which we all know about; but there is another fool trick that can easily be played with this knot, and I was just chump enough to work it. As it may be new to some of my readers, I will tell you how to get into my class. We were lowering a bed-plate, and as it was going down, to help keep it clear of the building, I took hold of A, Fig. 5 (you might take B, for a change) and gave it a good, strong pull, and down came the bed-plate with a rush. I was too busy saving the pieces just then to figure it all out, but I have since worried it out to this: My pull at A, Fig. 6, caused the loop to double back, as shown in Fig. 7, and then the weight of the bed-plate pulled A out of my hand, through the double loop,

and, presto! the trick was done. In making a flat knot with chains, a piece of pipe or wood should be run into it as shown by Fig. 5 to prevent jamming.

The next is made without passing the end, and provides two loops to which a tackle block can be hooked. Fig. 9 shows the start; Fig. 10, the second stage; Fig. 11, the

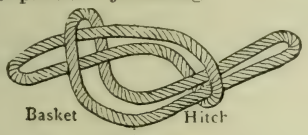


FIG. 1

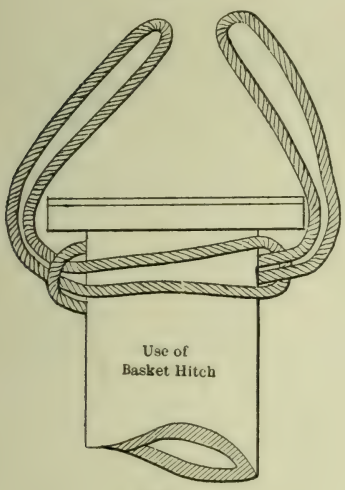


FIG. 2

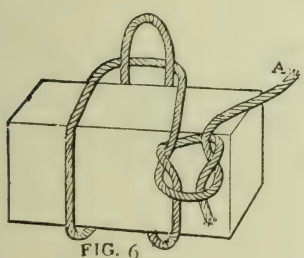


FIG. 6

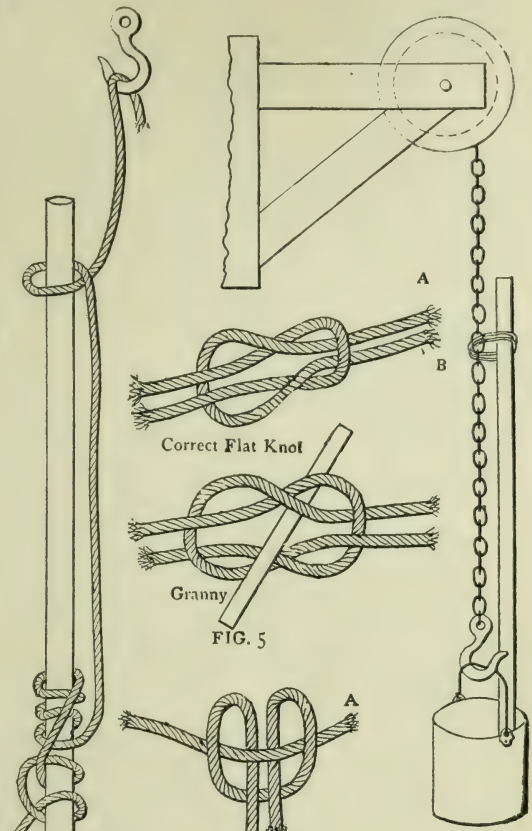


FIG. 4

FIG. 5

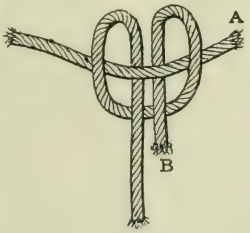


FIG. 7

FIG. 3

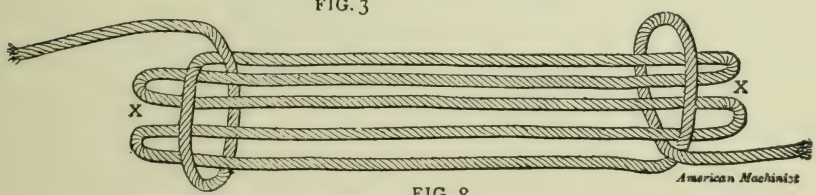


FIG. 8

KNOTS AND HITCHES.

Fig. 8 shows a good and safe way, known as a sheepshank, of shortening a long rope. It is self-evident that any amount and any length of loop may be used, but it must be carefully borne in mind that at least a 6-inch length of overlap loop at X X is essential to absolute safety.

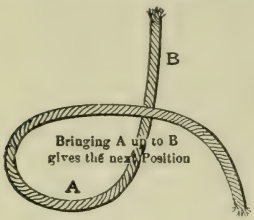
manner of rolling the two loops into the standing portion of the rope, and Fig. 12, the two loops X X brought vertically down (after rolling) and ready for service. The block or fall must be hooked into *both* loops. The above is a safe and reliable hitch that can be wiggled in at any point

in a rope, and besides being perfectly reliable, it is easily and quickly made and unmade.

Fig. 13 is an old and well-known friend of the rigger, but machinists should beware how they use it on Friday, as it has been known to betray a trust.

Fig. 14 is a simple and safe way to take a temporary hold, but as the mere shifting of the weighted loop will suffice to loosen the whole rig, the need of keeping meddlers away must be obvious.

Fig. 15 shows how in using a chain block whose hoisting and lowering range is



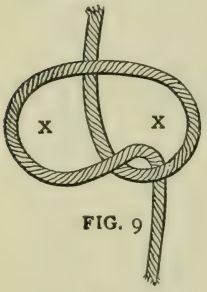


FIG. 9

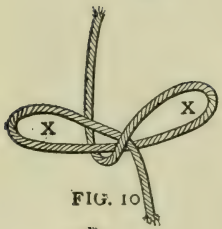


FIG. 10

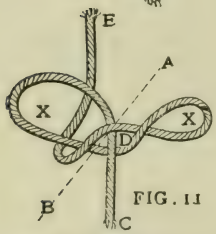


FIG. 11

The first turn of the loops XX should bring rope end C through loop D. Two more turns upward should then be taken along cross A B

FIG. 12

FIG. 13

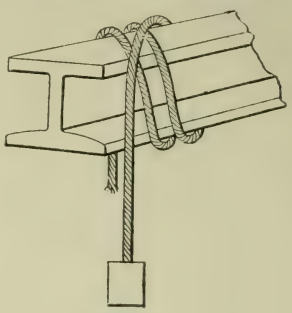


FIG. 14

FIG. 16

FIG. 17

FIG. 18

FIG. 19

FIG. 20

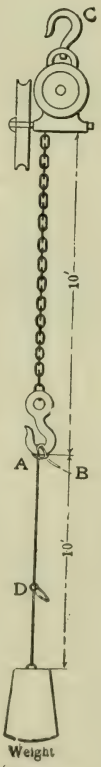


FIG. 15

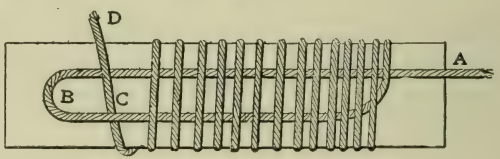


FIG. 21

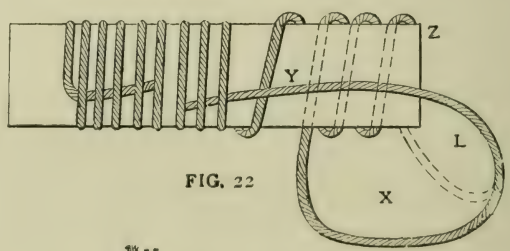


FIG. 22

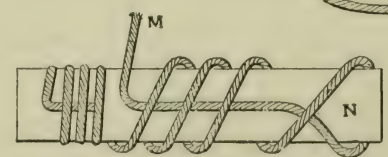


FIG 23

American Machinist

KNOTS AND HITCHES.

necessarily confined to the limit of its chain length, the weight may be raised or lowered to any distance. Thus in Fig. 15 the chain travel is only 10 feet, but the weight has to be raised 20 feet. We lower the chain and hook into the rope at A, hoist the 10 feet and make the free rope's end B fast to any convenient projection overhead (if necessary, even to the chain block's suspending hook C). We now unhook and lower the chain again for its new *previously prepared hold* lower down, as at D, and up she goes, the 20 feet, or any other old distance. We emphasize *previously prepared hold* advisedly, as, if not so prepared, it will be found impossible to wiggle in a hold for the hook in the tautened rope. Fig. 13 cannot be used for second holds, and positively must not be used as a starter, or first hold, because, after fastening at C, it will be found both hard and dangerous to slip the hook out of it.

Either the doubled-up, non-slipping loop, Fig. 16, or bowlines should be used all along the line.

Speaking of bowlines, the slack line X may go either in front or back of the standing rope Y, as shown in Figs. 17 and 18; but in either case, after going around Y, it must be passed through the loop Z in the manner shown at Fig. 19. Passing it through as shown at Fig. 20 cuts out the non-slipping feature and reduces the bowline to a farce.

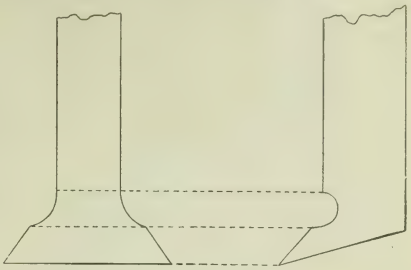
A broken hammer handle, a split monkey-wrench handle, etc., may be nicely repaired by the endless-wound splice, Fig. 21. The make-up is, we think, pretty clear as shown, and it is evident that by pulling at A the loop B will make a similar loop in D at C, and that continued pull will draw the crossed loops out of sight. The loop ends may then be closely cut off.

Fig. 22 is preferable for extra neat work, in that it does away with the bulge caused by the crossed loops. Until the loop X is got to all is plain sailing. The rope Y must then be held steadily in its place on the stick Z while the loop is swung around both it and the stick, as shown by the dotted outline. Only at the finish (shown in Fig. 23) should Y be allowed to move. Then it, as a part of loop L should be swung round the stick as shown at N. Setting the coils close and drawing up at M completes the job.

Always, and above all, in using ropes do not abuse them. Bagging, burlap, even waste or paper, if the first are not to be had, should always be interposed between a rope and all hard, angled, even if not sharp, edges.

A PLANER TOOL.

A handy planer tool for facing is made as shown herewith. This tool can be used



Handy Planer Tool

for either right or left-hand, or for both if need be. W. K. Smith, of Baltimore, contrived the tool.

RECIPE FOR TEMPERING CHISELS.

The following tempering recipe is sent us by a subscriber,

To 3 gallons water add 3 ounces spirits nitre, 3 ounces white vitriol, 3 ounces sal. ammoniac, 3 ounces alum, 6 ounces salt with a double handful of hoof parings. Heat tool to cherry red. This has put new life in steel that has apparently been burned, and is used to temper chisels for cutting French burr stones.

HOW TO TEMPER KNIVES.

After forging the knife to the shape and size desired make a box large enough for it and 4 inches deep. Fill the box two-thirds full with barrel salt and make a little trench in the salt. Heat the knife from the back cherry red; place it in the trench of salt, edge down; and cover it with salt. Let it remain until cool when it may be ground.

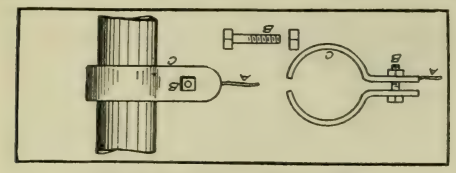
CONTRIBUTIONS INVITED.

Our readers are invited to send in any new kinks which would be of service to others. When you happen on something good in your own experience let us give others the benefit of your skill.

Use smoked shellac for cementing jet, first warming the broken edges.

MAKING GOOD GROUND CONNECTIONS.

For making ground connections to pipes the method here shown is especially good. The pipe should be thoroughly cleaned and brightened and then the simple clips



Good Ground Connection to Pipes

shown in the diagram fastened on. Use the nuts and screws from worn-out dry batteries for fastening the clamps to the pipe. The device can be readily removed for cleaning, says the Telephone Journal.

TO CONVERT A STEAM RADIATOR INTO A BAKE OVEN.

One who needs an oven to make various tests, will find the following description very timely. Sometimes there is not sufficient room to build one, and again it may be considered too expensive, consequently a person attempts to get along without it.

The electrician or repair man requires an oven to bake small field coils and armatures, and to test insulating varnishes, for one is not supposed to take the word of any one as to the quality of such an important article.

The cast-iron radiator should be 3 inches wide and 38 inches high, or its equivalent, to obtain a temperature of 190 deg. Fahr., which is the highest temperature allowable for insulating varnishes.

Nail strips of wood on the floor on at least three sides of the radiator. Make the oven from sheet iron, and set it down over the radiator. Fasten to the strips of wood with screws. There should be at least 10 inches air space above the radiator. Have a hinged door in the upper part of the front of the oven, with a clasp for locking. Fit the cork holder of a varnish can in the top of the oven, to retain a cork through which there is a hole to receive a tube thermometer. This is always a necessity. Heavy iron wire can be fastened from end to end of the oven on which samples can be placed to dry.

By leaving it uncovered, the oven will not cut off too much heat in winter. During this time, when not in use, the door may be left open.

Pieces of paper dipped in insulating varnish can be hung on the wires to make the heat test. Armalac and like varnishes are similarly tested. Endurance tests are make in this way for a period of two or three weeks.

FIRST THINGS TO DO IN CASE OF SPRAINS OR DISLOCATIONS.

The most important thing is to secure rest until the arrival of the surgeon. If the sprain is in the ankle or foot, place a folded towel around the part and cover with a bandage. Apply moist heat. The foot should be immersed in a bucket of hot water and more hot water added from time to time, so that it can be kept as hot as can be borne for fifteen or twenty minutes, after which a firm bandage should be applied (by a surgeon, if possible) and the foot elevated.

In sprains of the wrist, a straight piece of wood should be used as a splint; cover with cotton or wool to make it soft, and lightly bandage, and carry the arm in a sling. In all cases of sprain the results may be serious, and a surgeon should be obtained as soon as possible. After the acute symptoms of pain and swelling have subsided, it is still necessary that the joint should have complete rest by the use of a splint and bandage and such applications as the surgeon may direct.

Simple dislocation of the fingers can be put in place by strong pulling, aided by a little pressure on the part of the bones nearest the joint.

The best that can be done in most cases is to put the part in the position easiest to the sufferer, and to apply cold wet cloths, while awaiting the arrival of a surgeon.

HUNT'S TEMPERING RECIPE.

For heavy planer or lathe tools, when steel has been selected at random and is found a little too low in hardening properties for the purpose, to one pail of water (soft), add ¼ pound cyanide potassium, 1 pound salt, 1 dessert spoonful oil of vitriol. Draw the temper slightly.

FILLING AUTOMOBILE TIRES.

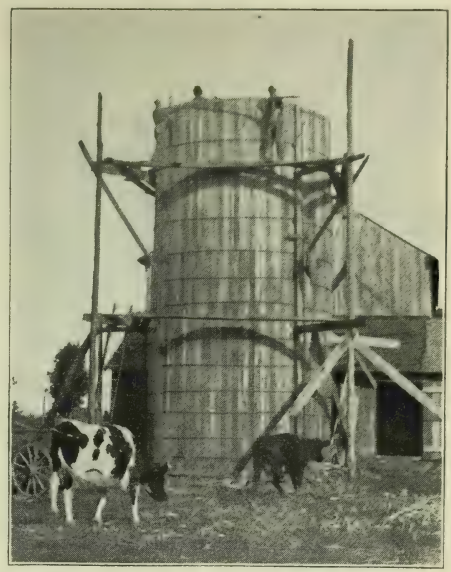
A fluid is now used for filling automobile tires and it can be injected without the tire being removed. It comes bottled and the owner of the machine can fill his own tires.

Construction and Use of a Silo

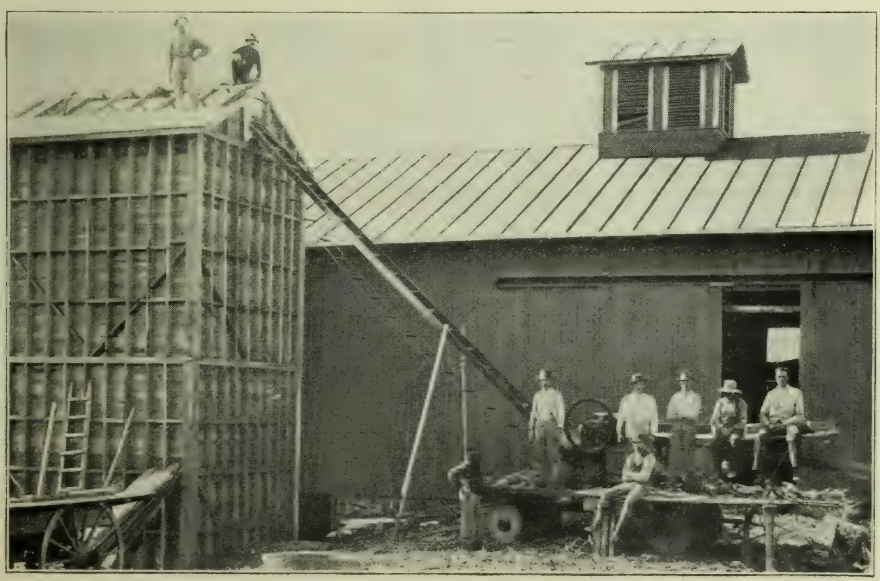
Provides Green Food for Cattle During Winter Months

The farmers of the country are today giving more attention to the building of silos and the raising of ensilage corn to fill them than ever before. Twenty-five years ago there was not a silo to be found in the United States. Subsequently the news of their advantages came to this country from France. At first square silos were built. Since that time there has been an evolution in the construction, and most modern ones are round. In Ohio, where the accompanying photographs were made, it is said that five years ago there was but one silo to every one hundred farmers. Today, especially in northern Ohio, it would be difficult to ride five miles in any of the rural districts without coming across a half dozen silos.

Ensilage corn grows much larger than ordinary corn, sometimes attaining a height of fourteen feet. While the stalks are yet green this corn is cut in the field by a machine drawn by a team of horses. After the product of several acres has been hauled to the site of a silo, a cutting machine is employed which chops the green stalks into lengths one and a half inches long. These are lifted by two methods to the opening at the top of the silo. One way is to convey them upon a continuous carrier such as shown in one of the photographs. By another method they are blown to the top of the silo through a large pipe. Silo filling time on the farm nowadays is something like threshing day. A large force of men



Constructing a Round Silo

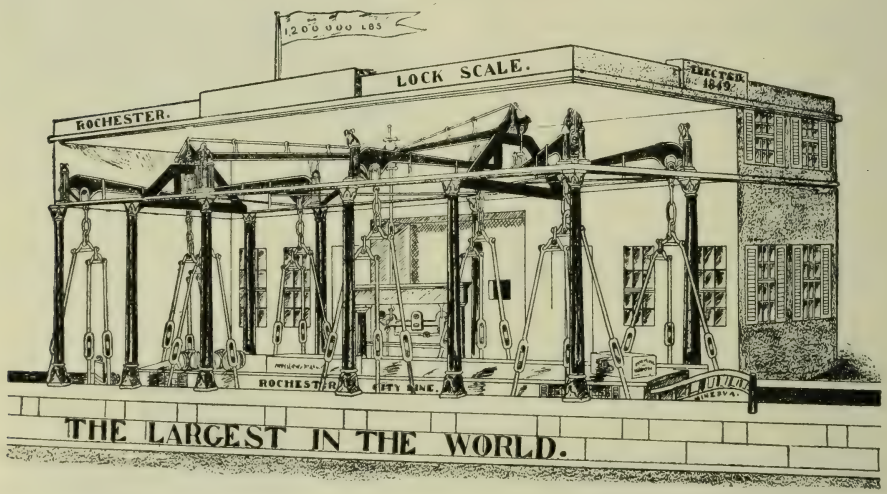


Filling a Square Silo with Ensilage

accompany the silo-cutting machine and the whole work is done in a day or two. Ensilage is valued as a milk producer. Cattle feeding on this green feed in winter give larger quantities of milk. Not only corn but clover, rye and grass may be converted into ensilage.

The silo is the building in which the ensilage is stored. A silo 25 feet high and with a diameter of 12 feet will contain 50 tons of ensilage—the product of four acres of ground. Some silos are built larger. Silos are usually built of pine, hemlock or cedar, although cement is now being used in many places. The cost runs from $75 to $200. The first operation in the erection of one of these towers is to dig an excavation for the foundation, fill it with stone and cement it over. Nowadays silos built at factories in different parts of the country are shipped to the farmer in pieces, all ready to be put up. Two or three hands erect them in a short time. The sides are airtight, in order that the contents may be kept green. The construction of a round silo is somewhat after the plan of the staves and hoops of a barrel. A series of doors is arranged down one side. In winter, beginning at the top, these doors are opened as the silo is emptied. Square corners are said to retard rapid and thorough packing at the time of the filling of the silos, therefore, even silos which are built square have rounded corners within.

Largest Scales Ever Built



The Great Scale at Rochester, Used for Weighing Ships on the Erie Canal--Capacity, 1,200,000 Pounds

In striking contrast to the diminutive scales used by apothecaries for measuring grains, scruples and drachms are the monster scales on the Erie canal used for weighing canal boats and their contents. They are the largest scales in the world today and the largest ever built. They were designed for ascertaining the tonnage of canal boats by weighing the boat and its load. It was a mammoth undertaking that is somewhat of a reflection on the intellectuality of New York state, for there are few 16-year-old boys in any other part of the world that could not determine a vessel's tonnage by its water displacement. H. A. Foss, in the Grain Dealer's Journal, says: "Just why the State of New York should have built a scale to ascertain the tonnage of boats is a mystery to me, as most any school boy knows how to figure vessel tonnage by displacement, which method would have done away with the immense expense incurred in the operating and building of so large a scale. This might possibly have been one of the boodle schemes which have been so numerous in the political management of the Erie canal."

The wonderful ship scales were erected in 1849. They have a capacity of 1,200,000 pounds.

MECHANICS FOR YOUNG AMERICA

HOW TO MAKE A BAGGAGE CARRIER FOR BICYCLES.

Here is an appliance for fastening books and packages on to the bicycle when starting for a ride in such a secure manner that they can neither be lost or injured.

A box 12 inches long, 8½ inches wide and 6½ inches deep is supported over the back wheel by two uprights clamped to the rear fork and by an iron clamp to the saddle-post. The box is made of well dried wood, the sides and lid being ¼ inch thick, the ends ⅜ inch and the bottom ¾ inch. The uprights A A, Fig. 1, are of ½x⅞-inch oak and are bolted to the bottom. They are strengthened by the iron brace B, Fig. 1, which is made of 1 x ⅛-inch iron. The uprights grip the rear forks by the simple clamp shown in Fig. 2. The iron strips c c Fig. 1, that run from the rear lower corner of the box to the upper forward corner and to the saddle-post are 1 x ⅛-inch iron and are firmly held to the box on each side by five screws. These strips are formed into the clamp shown in Fig. 3.

The lid opens backward and is held closed by the snap detailed in Fig. 4. The dotted outline shows the position the snap takes when the lip opens and closes; ½ to ⅛-inch iron is used in making this snap. The screw at the bottom of the iron piece acts as a hinge. A strap passing through the bottom so that it can be tightened around articles to be carried will prevent them from being shaken about and causing unnecessary noise. A coat of black enamel gives it a finished look. It has been tested with 135 pounds and found none the worse for wear.

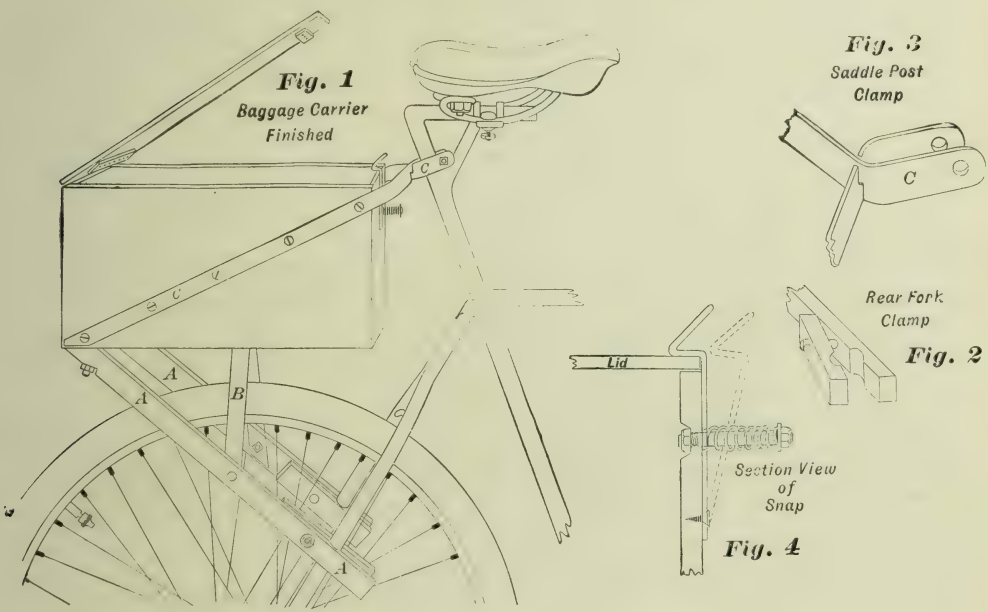


Fig. 1
Baggage Carrier Finished

Fig. 3
Saddle Post Clamp

Rear Fork Clamp

Fig. 2

Section View of Snap

Fig. 4

A WATER CANDLESTICK.

A glass of water makes a fine emergency candlestick. Weight one end of the candle with a nail just large enough to hold the candle in the water so that the water touches its top edge, but does not touch the wick, and then light the candle.

It will burn until the last vestige of wick is gone and the flame will not flicker. The melted tallow that runs down but serves to hold the candle more stationary.

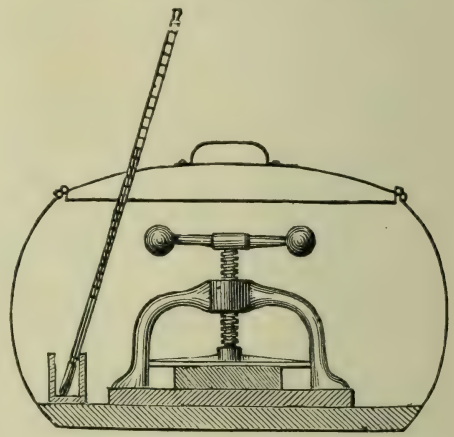
HOW TO MAKE RUBBER STAMPS

India rubber, especially prepared for stamp-making, should be procured from a dealer or manufacturer, if good results are to be obtained. As an experiment, it is possible for an amateur to prepare the rubber, but, in such cases, it is always attended with uncertain results. The mixed uncured rubber comes in white sheets, strong, firm and about one-eighth inch thick, and for its manipulation a press is indispensable, but can be home-made.

For the base of the press use a piece of iron, having two holes drilled in it at the middle of opposite sides, through which pass bolts, letting the thread ends extend upward and counter-sinking places for the bolt heads to keep the under side of the base level. Solder the bolts in place at the base. The upper part of the press, or the platen, is also of iron, cut so it can be swung off the bolts, rather than by removing the nuts and lifting it off. String a half dozen nuts, larger than those which screw on, on each bolt, so that when the upper nut on each is screwed to the extent of the thread the pressure will be communicated through the nuts wedged in between the platen and the upper nut. The bolt holes in the platen should be directly over those in the base. Distance pieces of an exact thickness should be provided for use on the base; these serve to keep the pressure even.

In preparing the mould, if type is to be copied, use rather large type with wide spaces and set up with high quads and spaces, or the type faces may be filled up by rubbing with either wax, or soap, lightly brushing off any that remains loose. The type so set should be locked into a frame. This may be made of two pieces of wood bolted together at both ends, or of printer's furniture. Place it on a flat surface (marble is good, but any perfectly smooth surface will do) and place distance pieces one-eighth inch higher than its upper surface on either side of it. Apply olive oil to the type faces and wipe off any excess. To form the matrix or reverse of the model, take a piece of iron larger than the inscription to be copied, and spread upon it to a depth of a quarter of an inch a putty made by mixing plaster of paris and water to the right consistency. By means of a table knife spread the plaster smoothly and then invert the plate upon the model and press down until the distance pieces are struck. Let it set 10 minutes and then remove. If care has been taken the matrix will be perfect. After it has thoroughly dried, preferably in an oven, saturate it with an alcoholic solution of shellac to strengthen it.

Cut a piece of smooth rubber, large enough to cover the matrix, from the sheet, throw this into a box of talc, or powdered soapstone, so that it receives a coating on both sides; dust a little of the powder over the matrix, also. Place the press on a support over a gas burner, or a kerosene lamp, and apply the heat. Place the matrix on the base of the press, dust off the piece of india rubber and place in the press upon the matrix and screw down the platen. Heat the press to 284 degrees F. (140 degrees C) and keep screwing down the platen so that the rubber, now soft and putty-like, is forced into every recess of the matrix. A

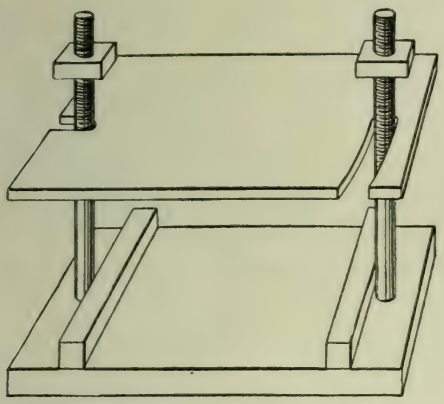


Fish Kettle Vulcanizer

thermometer is not necessary; some rubber always protrudes and the stage of the process can be told from that. At first it is quite elastic, then as the heat increases it becomes soft, then the curing begins and it again becomes elastic, so that, if a point of a knife blade is pressed against it, it resumes its shape when the point is removed. When this takes place it is then thoroughly vulcanized and the sheet can be removed from the matrix. Ten minutes, under favorable conditions, is sufficient time for moulding the rubber. By means of common glue, or a cement, composed of Stockholm pitch, 3 parts; American resin, 3 parts; unmixed india rubber 6 parts; oil of turpentine, 12 parts, heated and thoroughly mixed, fasten the rubber stamp to a wooden handle.

It is possible to dispense with the press in making stamps, where the work is not done in quantities, and use a hot flat-iron.

The matrix is placed on a stove at low heat, the rubber laid on and the hot iron applied. But a few moments are required to mould it.



Vulcanizing Press for Rubber Stamps

An old letter press if it be inclosed in a tin oven makes a good press, or all the necessary materials and apparatus can be purchased from a dealer. Any type such as all printers use will answer.

MOTOR TRAIN TRANSPORTATION OF TROOPS.

Germany is utilizing the motor car for the movement of troops, and the practice operation of these trains is becoming a familiar sight. The excellent character of the German highways makes the plan practical and economical. One motor car will draw several of the troop wagons containing as high as 200 soldiers with their ordinary marching

Motor Car Train for the German Army

outfit. Other wagon trains follow, carrying tents, ammunition, supplies, etc. The distance covered is about double that which the men would make in a day's march.

A Boston lawyer has invented a machine by which many difficult cases of hip dislocation are successfully treated.

COAL MINING DEPTH HAS A LIMIT.

Heat and dust are greater menaces to our coal supply than is the rate of exhaustion or any lack of ingenuity among our engineers. The Royal Coal Supplies Commission of England have fixed the coal mining limit depth at 4,000 vertical feet below the surface, and even that depth is not possible unless the air supplied for ventilation be very dry.

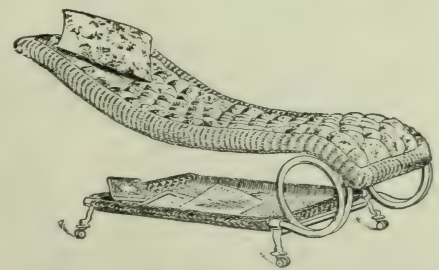
The rate of increase of heat varies in different districts. In some it increases one degree in 40 feet and in others one degree in 60, 80 or 100 feet. On the average, below a depth of 4,000 feet the human body cannot adapt itself to the conditions. Medical authorities state that the highest temperature in dry air at which a man can do hard work is 98 degrees. In air that contains very much moisture he cannot work where the temperature is above 84.

The fact that the air supplied to the miner must be perfectly dry removes one means devised for his comfort: that of spraying. Of course, the greater the heat the dustier the mine. For a while, spraying and other watering contrivances were used to lay the dust, but these means had to be abandoned because they increased the humidity of the air.

Means of conveying the coal from great depths, means of ventilation and in fact nearly all the engineering problems of the coal mine are comparatively easy beside the problem of cooling the air so the men can work below the limitation depth.

VIBRATING FURNITURE.

The illustration is self-explanatory of the latest thing in comfort furniture. Couches, rockers and cribs are now made in this



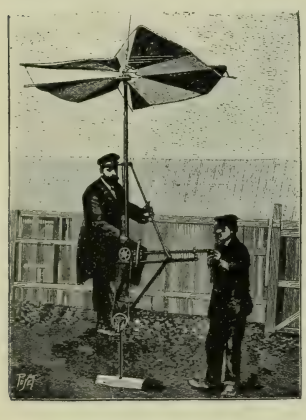
An Easy Couch

style which is light and airy. The tray at the base is large enough to contain books and other reading matter.

FRENCH INVENTORS ARE WORKING ON AUTO FLYING-MACHINES.

The French inventors are diligently studying the subject of aerial navigation in its three branches, namely, elevation, suspensibility while moving about and propulsion, learning all they can about the first branch before proceeding to the second. On the subject of elevation some interesting results have been obtained.

The first model, while very different from the more recent ones, made a good foundation for further experiments. It was a bicycle-like affair in which the legs of the aerial navigator worked pedals which in turn caused the fans or helices at the top to rotate. By this means it was fully demonstrated that a pull of 15½ pounds could be obtained.



Pedal Test

In the next model a gasoline motor supplied the power with a greater pull of 44 pounds. Frequent changes were made in the helices until mathematical correctness as to size, weight and form had been obtained. This brought it down to the use of two large helices and two smaller ones, additional support being required for the smaller ones which create such a violent wind that no one can venture near them. These, with the oil motor gave a resistance of about 159 pounds.

The next change was the substitution of a 9-horsepower electric motor for the gasoline motor. Results were highly increased by this and the inventors believe the question of elevation is settled. The small helices rotate 400 times to the large helices' 200.

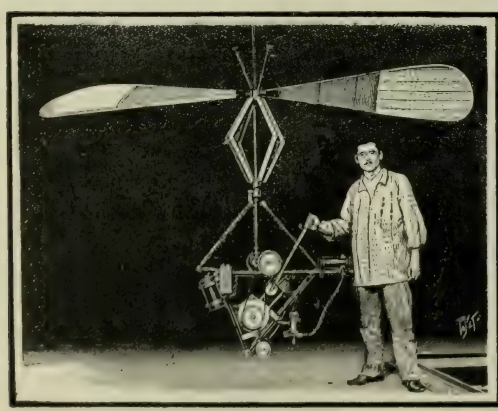
Interesting developments along the lines of suspensibility in motion and propulsion are expected.

FRENCH MUSHROOMS GROWN IN CAVES.

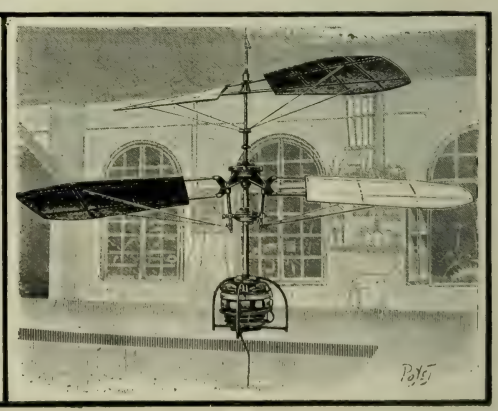
French mushrooms, held as a rare delicacy by all epicures, are raised in caves. Those consumed in Paris are grown in the disused quarries which honeycomb the country to the south of the city. Some of these excavations are of enormous extent and some have horizontal galleries or levels at various depths. But usually they have only one gallery which may be half a mile in length and from 30 to 150 feet below the surface. John K. Gowdy, United States consul-general at Paris, says:

"These galleries are generally from 7 to 10 feet in height. They are in most cases wide enough for two rows of beds with a footway 18 inches wide down the center. About three tons of these cave-grown mushrooms are sent to market every day and the total value of the trade is about $3,000,000 a year."

In the Ozark mountains of Missouri and some other parts of the United States mushrooms are also successfully grown in caves, while in recent years cellars have been utilized for the purpose.



Gasoline Motor



Electric Motor

THE IDEAL SIGHT RESTORER

WE RESTORE SIGHT!

GLASSES RENDER DEFECTIVE VISION CHRONIC.

Write for our ILLUSTRATED TREATISE, Mailed Free.

THE IDEAL COMPANY, 239 BROADWAY, NEW YORK.

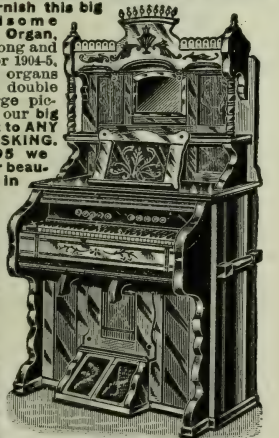
THE ORIGINAL CANNON-BALL LINE.

One of the exhibits of the life-saving service at St. Louis will consist of the original mortar and first cannon ball used in this country to assist in rescuing persons from a wrecked vessel. The cannon ball was only recovered a few years ago, after having rested on the bottom of the ocean for nearly fifty years. The rescue in question occurred in 1850 on the New Jersey coast, and 200 persons were saved. The cannon ball—a murderous looking object nearly a foot in diameter—with a rope attached, was fired from the mortar and landed plump on the deck. The vessel went to pieces and the cannon ball was buried in the sands among the ship's timbers. The Jersey shore at that place is constantly shifting by the action of the wind and waves, and some ten years ago the waters receded and exposed the remains of an old wreck. Among the timbers of the craft was found the cannon ball fired to carry a line to the shipwrecked crew and passengers.

Have you seen "Shop Notes"? Of interest to every mechanic.

$19.90 BIG PARLOR ORGAN

FOR $19.90 we furnish this big handsome solid golden oak Parlor Organ, stands 6 feet high, 4 feet long and 2 feet wide, latest style for 1904-5, guaranteed the equal of organs sold by others for nearly double the price. Shown by a large picture and fully described in our big free Organ Catalogue sent to ANY ADDRESS FOR THE ASKING. **AT $25.95** to $51.95 we sell other beautiful ORGANS, all made in our own organ factory and sold direct to you at only a little above actual manufacturing cost, at much LOWER PRICES THAN ANY DEALER CAN BUY. **WHY** we can build and sell the best ORGANS in the United States for so much less money than all other manufacturers and dealers, is all explained in our new free Organ Catalogue, OUR NO MONEY WITH ORDER PLAN, FREE TRIAL offer, OUR TWENTY-FIVE YEARS BINDING GUARANTEE, all fully explained in the BIG FREE ORGAN CATALOGUE, SENT ON REQUEST.



HAVE YOU ANY USE FOR AN ORGAN? If not, have you a friend who could use an organ if the price was low enough, the offer liberal enough, the greatest chance ever known? If so, cut this ad out and send to us, and the catalogue, our several propositions, and our new and most astonishingly liberal offer ever made, will all go to you FREE by return mail, postpaid. Write for our Free Organ Catalogue at once. Address,

SEARS, ROEBUCK & CO., Chicago, Ill.

A Free Trial Bottle of

Hydrozone

sent on receipt of 10c. to pay postage. Positively relieves and cures Oak or Ivy Poisoning, Sunburn, Prickly Heat, Hives, and immediately takes the sting out of Mosquito Bites. A marvelous remedy for burns, and will positively prevent blood poisoning from cuts or abrasions.

Sold by leading druggists.

None genuine without my signature.

Prof. Charles Marchand

L-63 Prince St., New York.

Send for free Booklet on "How to treat diseases," containing hundreds of testimonials of wonderful cures.

AGENTS WANTED Sell our $1.00 bottle of Sarsaparilla for 35c; best seller; 200 per cent. profit; write today for terms and territory.
F. R. GREENE, 116 Lake Street, Chicago

MAKE YOUR OWN MIRRORS

And make big money making mirrors for others. Success guaranteed. We will send complete printed directions and formulas for making mirrors, boring holes in glass, frosting, foiling, gold leafing, embossing, chipping, etching, also how to etch photos on glass, etc., all for $1. Address

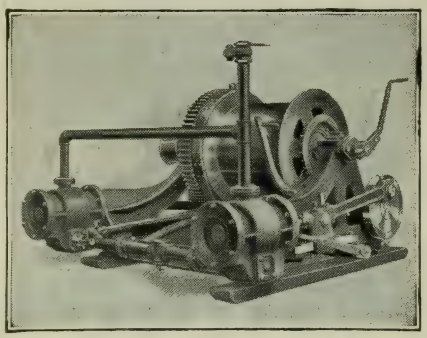
G. L. Patterson & Co., Chicago, Ill.

CARBURETTOR TROUBLES CURED

The Landgraf Carburettor will make your engine go if there is any go in it. We guarantee it.
PRICE, $12.50 FOR MOTORCYCLES AND CYLINDERS UP TO 3 1-2 x 4

Crank Hangers for motorcycle builders; special, wide bracket with lugs for drop frame to take large motor. Crank hangers to fit any make and style of bicycle. SPROCKET MILLING AND MACHINE WORK.
Every motorcycle builder should get our circulars on carburettors and motorcycle hangers, and every bicycle shop should use our repair hanger. Write us for prices and trade discounts.

THE A. & J. MANUFACTURING CO., - 17 South Canal St., Chicago



THE QUINCY HOIST

8 x 10	Cylinders,	Drum 14 x 20,	$496
8 x 10	Cylinders,	Drum 24 x 24,	$505
8 x 10	Cylinders,	Drum 30 x 30,	$525

YOUR CHOICE; FRICTION OR REVERSIBLE

Delivery f. o. b. Quincy, Ill., or Chicago

No discount from above prices.
Will ship subject to inspection and approval.
Modern, Quick, Strong, Efficient. Just the thing for pulling up cars or for small mines. Get 'em in stock. Order one.

WILLIS SHAW, - - Chicago
SOLE DISTRIBUTOR

HARDWARE AND METAL SPECIALTIES

Manufactured on Contract

PUNCHES AND DIES
SPECIAL TOOLS
GEAR CUTTING

CRAIG MANUFACTURING CO.
39-43 West Washington St.. Chicago. Ill.

WHERE CLEAN WATER COMES HIGH.

In one of the northern districts of England, in a little town, the authorities have established a fine public bath. In order to make the undertaking self-sustaining a fee is charged the bathers, and over the door is a sign which says: "Rates for Baths—Monday, 6d; Tuesday, 5d; Wednesday, 4d; Thursday, 3d; Friday, 2d; Saturday, 1d."

An American whose curiosity was aroused at this sliding scale was given the explanation. Water is scarce in the town, and consequently high in cost. The baths are closed Sunday, but early Monday morning the tank is emptied and refilled. That day the charge is 6d. As the water is not changed again for one week, and is in constant use during all that time, the price is graded in proportion to the length of time it has been in use.

As the traveller happened to be there on the day when the price was only 1d, he concluded he did not require a bath just at that moment.

COLD ZONE MOVING SOUTH.

The cold summers of the past few years causes a noted French scientist to predict a movement southward of the cold zone. The Literary Digest translates the following from his article:

"Has any definite light been thrown on this question of precessional action? We can hardly pretend that it has. Incontestably we must still observe and study it. But we are entitled to think that though we may not have reached the goal, we are not far from it. . . . We are moving toward a cold maximum. . . . We are doing only what the earth has done since the beginning and will continue to do to the end. Our regions, like others, will see again what they have already seen—that is to say, to go back to the subject of the vine, we can predict in advance the fate that is reserved for it. Without any doubt, in less than 400 years the champagne country will have lost its vines, and 500 years hence Bourgogne and the Gironde will themselves be deprived of vineyards. There will remain only Provence, which 2,000 years ago began viticulture. In its turn it will have to yield, probably within 1,500 or 1,600 years. As for Paris, in 10,000 years at the culminating point of the present climate phase it will have about the same annual temperatures as Berlin has now."

WE CAN KILL THOSE

IGNITION TROUBLES

DURO BATTERIES ARE THE MOST DURABLE, COMPACT and EFFICIENT

The Only Way of Obtaining a Mileage Guarantee

Chicago Battery Co.
1421 Michigan Avenue, Chicago

50-CENT CATALOGUE IT WILL COST YOU NOTHING

FREE

FOR COMPLETE INDEX SEE PINK PAGES IN MIDDLE OF BOOK
SEARS, ROEBUCK AND Co.
CHEAPEST SUPPLY HOUSE ON EARTH
OVER TWO MILLION DOLLARS
REFERENCES
THE WORLD
THE GREAT PRICE MAKER
THE REAL VALUE OF THIS BOOK IS PLAINLY SHOWN IN EVERY PRICE QUOTATION
THIS BOOK WILL BE SENT TO ANY ADDRESS FREE BY MAIL POSTPAID ON APPLICATION
114
CHICAGO ILL USA
SEARS, ROEBUCK & CO.

TO RECEIVE BY RETURN MAIL, POSTPAID, the largest, handsomest, most complete and by far the lowest priced general merchandise catalogue ever published. NEVER BEFORE SOLD FOR LESS THAN 50 CENTS. Worth easily $5.00. Now FREE to anyone for the asking. Cut this ad. out and send to us or on a postal card, say: **"SEND ME YOUR BIG No. 114 CATALOGUE FREE," and it will GO TO YOU BY RETURN MAIL FREE, POSTPAID.**

ENORMOUS SIZE, BIGGER THAN EVER. **1,200 large 9x12 pages, over 100,000 quotations, over 10,000 illustrations.** Our new and marvelously low price making policy fully explained; 55 vast merchandise departments fully represented, much larger than ever before; prices much lower than ever before. **New and lower prices** on everything carried and sold in **the largest store in the world.** Makes all other catalogues look very small. **Makes all other prices look very high.**

WHAT BELONGS TO YOU **is shown in one section of the Big Book. If you have ever bought anything from us, or if you ever** do buy anything from us, **then something in this big business belongs to you,** and **it is** all explained in a 16-page section **OF THE BIG BOOK. THIS PART OF THE BOOK is YOURS, not OURS; The most liberal offer ever heard of.**

16 PAGES—YOUR PAGES **devoted to explaining how you can make money by sending to us for goods.** How you can make money by getting others to send to us. **A BIG CHANCE FOR DEALERS. MONEY MAKING MADE EASY FOR EVERYONE. THE GRANDEST OFFER OF THE AGE. AN OPPORTUNITY THAT IS YOURS—SOMETHING THAT BELONGS TO YOU.**

QUICKER SHIPMENT **THAN ANY OTHER HOUSE.** As we carry in stock constantly all kinds of merchandise in amounts far greater than all other mail order houses combined and we have factories and warehouses for immediate shipment South, North, East and West, we can ship you goods much quicker than any other house. If you send your order to us, no matter where you live, you will get your goods in just a few days, usually less than one-half the time it takes to get goods from other houses, and on a great many goods you order from us you will have less than one-half the freight charges you would have to pay if you ordered from anyone else, for if your order contains goods we can ship from one of our factories or warehouses near you, we will ship from the warehouse nearest you, bringing the goods to you in a day or two at a very low freight rate.

OURS IS THE LARGEST MAIL ORDER HOUSE IN THE WORLD.

We sell and ship more goods than all other mail order houses in the United States combined. Other mail order houses are mere side shows compared with ours. If everyone only knew how much **greater values we give** on all kinds of merchandise than any other house, no other mail order house would ever again **get even a single order.**

THE ONLY MAIL ORDER HOUSE

that owns or controls a vast number of factories located north, south, east and west, situated so that we can ship many goods from our factory or warehouse nearest you, making quick delivery and very low freight charges. Southern factories and warehouses for southern people. Northern factories and warehouses for northern people, etc.

OUR FREE BIG No. 114 CATALOGUE **EXPLAINS WHY, AS COMPARED WITH ANY OTHER HOUSE, WE CAN MAKE PRICES SO MUCH LOWER, SHIP SO MUCH QUICKER, FREIGHT CHARGES SO MUCH LOWER, QUALITY SO MUCH HIGHER,** why we can give every customer a big money making opportunity.

SEND FOR OUR FREE No. 114 CATALOGUE. Cut this ad. out and send to us, or on a postal card say, "Send me your No. 114 Catalogue" and the big book will go to you by return mail postpaid, free; **all our new offers, our new money making proposition;** an opportunity never before known, **all will go to you free by return mail, postpaid. DON'T BUY ANYTHING ANYWHERE UNTIL YOU GET OUR NEW No. 114 CATALOGUE. Tell your neighbors not to buy anything at home or elsewhere until they write for OUR No. 114 CATALOGUE.**

DON'T BUY A CATALOGUE. Don't send anyone 5, 10 or 15 cents for a catalogue, when you can **get our BIG No. 114 BOOK for nothing. FREE FOR THE ASKING. WORTH 100 TIMES AS MUCH TO YOU** as all other general merchandise catalogues printed. **WRITE FOR IT TODAY. DO IT NOW. IF YOU SEND FOR THIS FREE BIG No. 114 CATALOGUE,** hand our old catalogue (if you have one) **TO SOME FRIEND** and in your letter or on the postal card give us the **NAME OF THE PARTY TO WHOM YOU HANDED OUR OLD CATALOGUE.**

Address SEARS, ROEBUCK & CO., CHICAGO, ILL.

PAYING THE HANDS AT A BIG AMERICAN FACTORY.

In many of our large American factories the task of paying off the men each week means a hard day's work for a large force of clerks. In the early morning the bulky packages of money in many denominations are carried under guard from bank to carriage, conveyed to the office of the corporation and then the hard work begins.

At each of a number of polished tables sit several clerks and when the paymaster throws one of the heavy bags of money on the table these clerks fall to and count for all they're worth. As each bag is counted it is checked off the list held by the paymaster and if the amounts do not tally with his memoranda it must be counted again. This work requires fully an hour, and is, perhaps, the easiest part of the task.

Then before the first man at each table is placed a pile of bills, heaps of small change and a tray full of envelopes, each of which bears the number of a hand and the amount of money due him. The first man at each table picks up an envelope, counts out the required sum and passes it and the envelope to the next clerk, who likewise counts it and passes it on. In this way all the men at one table count the money in turn and the last one packs it into an envelope. An error could not easily occur and the envelopes pass from hand to hand with hardly a pause.

The money remaining when all the envelopes are filled is then counted and added to the sum total of that in the envelopes. If it balances with the original amount, well and good; if not, it must all be counted again. A recount is rarely necessary, however.

The paymaster makes what reductions in the pay may be necessary for any reason and the envelopes are then packed for the respective pay stations at the factories. Each separate station is in charge of a clerk, who having arrived at his station, arranges the contents of his box on a shelf, stations himself behind the wire grating, while an assistant stands just outside. Shortly after six the line of hands begins to form. The first man hands his check to the assistant, who calls out the number. The clerk hands the assistant the proper envelope; the assistant compares it with the check and hands it to the hand. Gradually the line marches steadily past, and meanwhile a steady stream of envelopes flows out.

In 20 minutes about 800 hands have been paid and the clerks go back to the office, count over the checks received, add up any envelopes which may be left, and so the all day's job is ended.

89 CENTS FOR A NEW 1905 HEATING STOVE

HOW WE CAN SELL a new 1905 model high grade heating stove under our BINDING GUARANTEE for only EIGHTY NINE CENTS. Not a deposit of 89 cents, with something to pay later on, but just 89 cents to pay; no more, no less. HOW WE CAN DO IT AND WHY WE DO IT IS FULLY EXPLAINED IN OUR NEW FREE 1905 SPECIAL STOVE CATALOGUE, JUST OUT.

OUR FREE STOVE CATALOGUE illustrates and describes our New 1905 Style Heating Stove, which we sell for 89 cents; explains our new and marvelously low price making policy, illustrates and describes an almost endless variety of Heating and Cooking Stoves and Steel Ranges; all kinds and styles of Hard Coal, Soft Coal and Wood Heating Stoves, Steel Airtights, direct and double draft; plain and fancy cast iron and steel and iron direct draft, double draft and base burning heating stoves. Everything in stoves at prices so astonishingly low that you will be surprised and pleased.

OUR FREE CATALOGUE explains our 30 Days' Free Trial Plan, our Pay After Received Terms, our Safe Delivery Guarantee, explains our Binding Quality Guarantee, explains our plan of shipping the day your order is received, so you will only have to wait a few days; tells how we make freight charges very low no matter in what state you live. OUR FREE CATALOGUE shows an illustration of our own stove foundry, the largest in the world; tells all about why we can make prices on all kinds of stoves so very much lower than any other house.

OUR FREE CATALOGUE is the largest, handsomest, best illustrated, most interesting and MOST COMPLETE SPECIAL STOVE CATALOGUE EVER PUBLISHED and tells EVERYTHING known about stoves.

WRITE FOR OUR FREE STOVE CATALOGUE. Cut this ad out and send to us, or on a postal card say: Send me your FREE Stove Catalogue, and the big stove catalogue will go to you by return mail, postpaid, FREE. You will get the most astonishing stove offer ever heard of; you will receive a new and most astonishingly liberal stove proposition.

DON'T BUY A STOVE anywhere and tell your neighbors not to buy a stove of any kind until they first write for our New Special Stove Catalogue and get The Big Book. THE NEW OFFER OF OURS; OUR LATEST STOVE PROPOSITION. WRITE TODAY. DO IT NOW. WE WILL TELL YOU SOMETHING YOU OUGHT TO KNOW. Address,

SEARS, ROEBUCK & CO., CHICAGO, ILL.

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,

127 NASSAUST. ROCKFORD, ILL., U. S. A

RUPTURE

Our 24-page book free describes the greatest invention of the 20th Century, for the relief and cure of Rupture. Shows interesting photos from life and contains new and valuable information. Greatest trial offer ever made by any firm. You will be interested. Write today.

DENCE & MERY, 160 Mery Block, Toledo, O.

SEE SPECIAL OFFER

ELSEWHERE OF OUR NEW BOOK

"Popular Mechanics Shop Notes"

JUST OUT

TYPEWRITERS ALL MAKES

All the Standard Machines Sold or Rented Any Where at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g Typewriter Emporium, 196 La Salle St., Chicago

---

BILL MAGEE OF PINE NUT.

An Epic of a Nevada Mining Camp.

'Twas a dreary day at Pine Nut, and gloom was everywhere;
There was sadness in the little camp and sorrow in the air.
A more doleful set of faces one would not care to see,
The day the boys laid out the corpse of poor old Bill Magee.

'Twas pneumonia or whisky—they couldn't quite decide—
That sent the fleeting soul of Bill across the Great Divide;
But with very little wrangling over life's extinguished lamp,
They arranged a mighty funeral to advertise the camp.

I know of places where a man who shuffles off his coil
Is pitched face down with boots on in scarce a foot of soil;
But now the boys of Pine Nut said such things had had their day,
And they'd bury Bill with socks on, in the decent Christian way.

So they hired a Carson preacher, of noted funeral skill,
And agreed on forty dollars for some extra words for Bill.
There are some parsons in the land that 'd go a little higher,
But this man was no grafter but my own illustrious sire.

At two o'clock the coffin passed through Bill's wide cabin door,
With Otto Shultz and Joe Raycraft and Jackson at the fore.
Tony Kramer, with his goggles, helped to hold the coffin up,
Then followed tall Miles Johnson and his little brindle pup.

Pratt, with a Heitman flour-sack sewed firmly on his pants;
Bill Peckham, Baldy Adams, Lew Stevenson, Old Nance;

And loomin' up ahead of all, the big long-bearded Zern,
All headin' toward the bourn from which no travelers return.

They finally reached the grave that yawned beneath a spreading tree,
The parson told how pure had been the life of Bill Magee;
And as they heard the kindly things the clergyman had said,
They almost thought that angel's wings was sproutin' from the dead.

They lowered the coffin down with hands as steady as a clock's,
And then began to shovel in the gravel on the box,
When suddenly they stopped the work. Somebody hollered "Whew!"
And then a golden nugget came a-flashin' into view.

Joe Raycraft, straddlin' o'er the grave called out, "I locate here;"
And then Lew Stevenson gave Joe a swat upon the ear;
Next Johnson jumped aboard of Lew in a most decided way,
And then the savage brindle pup plunged headlong in the fray.

Then Baldy Adams pulled his gun, and Billy Peckham his,
And in 'bout a half a second the lead begin to whiz.
For several humming minutes it was a fearful fray,
With all upon the ground before the smoke had cleared away.

The parson, when he heard the shots, whipped up his old gray mare,
To find the coroner and send that functionary there.
When that official reached the spot, immediately did he
Tack a location notice on the headstone of Magee;

Remarkin' to the wounded: "I regret you can't agree.
I'll record these placer diggin's and consider it my fee."
And so before the sun was down the records was complete,
All in accordance with the law at Douglas county seat.

And now that thrifty coroner, as many are aware,
Is livin' off that placer claim, a multi-millionaire,
While the parson oft has mentioned, confidentially to me,
From that eventful day to this he never got his fee.

—Sunset Magazine.

HOW TELEPHONES PAY FARMERS.

Eggs are high in Indiana. Claton B. Hunt, one of the oldest and largest produce dealers of Indiana, gives part of the credit to the telephone for the better prices farmers now receive for eggs and other farm products. He says: "When a huckster drives his wagon up to the home of a farmer and offers a price the farmer need not take the huckster's word. He steps to the telephone, calls up the town dealer, learns the price and sells his produce without fear of being beaten."

CONSOLATION.

We approached the Czar.

"You do not seem worried because the Russian fleet is bottled up?" we interrogated.

The Czar smiled a wan smile.

"My dear friend," he said, slowly, "don't you know, our ships are like wine; the longer they are bottled the better."

THE WINGET CONCRETE BUILDING BLOCK MACHINE

Automatic Adjustable

Makes any size or shape block required in ordinary building operations

Straight & Corner Block

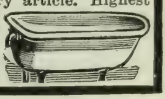
A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

LOW PLUMBING BILLS

Get them by paying right prices for supplies. We sell

SUPPLIES AT WHOLESALE

You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.



B. P. KAROL,
229 W. Harrison St., Chicago.

ELECTRIC LIGHTER

For Gas and Gas Ranges

A perfect, safe, economical lighter. Saves its cost in matches

No Household Should be Without One
The only really successful lighter on the market.

PRICE, DELIVERED IN CHICAGO, $1.25

To any part of the U. S. or Canada, Shipment Prepaid, $1.50. AGENTS WANTED. Address

MODEL ELECTRIC CO.
Dept. A, 85 5th Ave., Chicago, Ill.

Less Than 4 Months to Christmas

Write for our plan by which you can earn

$15.00

for "Christmas Money."

POPULAR MECHANICS
Journal Bldg., Chicago

BIG PAYING BUSINESS
FOR MEN AND WOMEN.

Write for names of hundreds of delighted customers. Make $30 to $50 weekly. Do business at home or traveling, all or spare time, selling Gray outfits and doing genuine gold, silver, nickle and metal plating on Watches, Jewelry, Tableware, Bicycles, all metal goods. Heavy plate. No experience, quickly learned. Enormous demand. No toys or humbug. Outfits all sizes. Everything guaranteed. Let us start you. We teach you FREE. Write today. Address,

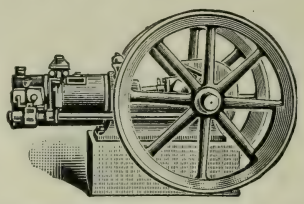
H. GRAY & CO., Cincinnati, Ohio.

KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago

OUR EXHIBIT at the St. Louis World's Fair

consisting of **17** Gas and Gasoline Engines, **11** of which are piped up and running, is the largest, most comprehensive and most attractive display in this line ever made.

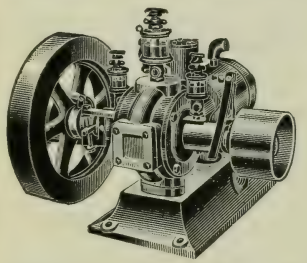


Our friends will find at the space good drinking water, electric fans, comfortable chairs and writing materials. Visit us, see our exhibit and test our hospitality.

The OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street **MINNEAPOLIS: 318 3rd Street** **OMAHA: 1108 Farnum St.**

SMALL GASOLINE ENGINES

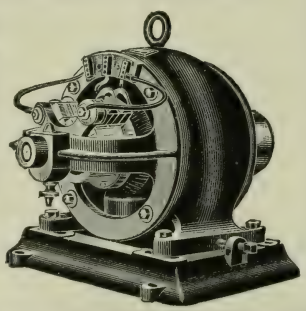


Latest
Simplest
Cheapest
Best

Our new type 1 h. p. gasoline engine has no equal; suitable for all purposes where light power is desired. Starts instantly and runs until you stop it. Has automatic governor; runs at varied speeds.

MAKE YOUR OWN ELECTRIC LIGHT

For residences and small individual isolated plants.
Finest electric light cheaper than kerosene. No combination lighting outfit such as we offer, has ever before been placed on the market.
Price within the reach of all. Send for full descriptive circulars.



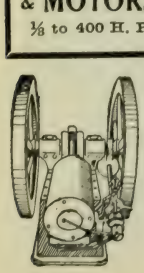
Martin Mfg. Co.,
180 W. Madison St.,
CHICAGO

GAS and GASOLINE ENGINES

...1 H. P. to 125 H. P...

DYNAMOS & MOTORS
⅛ to 400 H. P.

Complete Lighting or Power Plants for individual uses, large or small, including Engine, Dynamo and Switchboard. Tell us your requirements.
THOMSON CO., 309 Dearborn St., Chicago



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY
25 West Randolph Street, Chicago

LIFE MASKS PREVENT DROWNING.

A life mask has been invented by a German who says many persons who can swim are drowned when wrecked or accidentally thrown into the water, by the waves dashing in their faces. A life preserver must be worn also, and the mask has valves which keep the water from the face but respond to suction readily, enabling the wearer to breathe.

DRY METHOD FOR DEGREASING WOOL.

A new method of degreasing wool and machinery for the same have lately been patented by a German, writes United States Consul Pike, of Zittau, Germany. Infusorial earth is applied to the wool by a current of air and absorbs the grease and cleans the wool evenly throughout. Skin wools are now cleaned with strong alkalies, and the new method will be a great improvement in that the dyes take better where the alkalies are not used.

THE COMPRESSION OF WATER.

Water is so nearly incompressible that it is customary to consider it absolutely so. Professor Toit, however, informs us that were the water in the lower levels of the ocean relieved of the weight above it—i. e., if the sea water were not compressed by its own weight—the level of the sea would be 116 feet higher than it is. Were this true some 2,000,000 square miles of what is now dry land (4 per cent of the land surface of the globe, and in many respects the most valuable portion) would be submerged, and most of the greatest cities on the globe obliterated, including New York, London, Philadelphia, Paris, St. Petersburg, Constantinople, Canton and Tokyo. The present habitations of some 100,000,000 of the inhabitants of the globe would be engulfed.

IT CURED HIM.

A sad-looking man went into a drug store and asked the druggist if he could give him something to drive from his mind thoughts of sorrow and bitter recollections. The druggist nodded, and put him up a mixture of quinine and worm-wood and rhubarb and epsom salts, with a dash of castor oil, and gave it to the man; and for six months he could not think of anything except new schemes for getting the taste out of his mouth.

WILL DISTILL ALCOHOL FROM PEAT.

At Reedsburg, Prussia, a distillery is being erected at which alcohol will be distilled from peat, reports S. P. Warner, consular agent at Gera, Germany.

Alcohol can be distilled from peat so much more cheaply than it can be distilled from other substances that the company expects to sell it for fuel.

FOR SALE.

FOR SALE—Telephone engineering course in International School cheap, or will trade for 4x5 kodak or camera. Will also sell a brand new specially constructed lineman's set, which cost $16, for $9. Baker, care Popular Mechanics.

FOR SALE—Sun-dial watch; not a toy, but a watch that will indicate the correct time by the sun's shadow; never wrong, always shows the correct time. Twenty-five cents. G. E. Wagner, 142 S. Market St., Mt. Carmel, Pa.

FOR SALE—Popular Mechanics from No. 2 of Vol. 2 up to No. 7 of Vol 6. Best offer gets them. Remember back numbers are valuable. Martin Buehler, Jr., 580 Milwaukee Ave.

FOR SALE OR EXCHANGE—Mandolin, Lyon & Healy make; cost $18; in fine condition. Camera preferred in exchange. E. A. Montooth, Box 115, Salineville. Ohio.

FOR SALE—Complete course in Mechanical-Electrical Engineering (American School of Correspondence) and ten volume library accompanying. Owner's work leaves no time for study, will sacrifice this $65.00 course and books for $37.50 cash. Address B. B., Popular Mechanics.

REAL ESTATE BARGAINS.

FINE FARM FOR SALE near Bowling Green, Mo., 270 acres; all under cultivation; new 8-roomed house and barn; one of the finest improved farms in Missouri. Plenty of outbuildings; springs and wells; rural free delivery; large crops of corn, hay, oats and grass; very cheap. Real Estate Clearing House, Journal Building, Chicago, Ill.

TWO-STORY FRAME MILL BUILDING, 80x24, for sale in Humphreys county, Tenn; engine room adjoining; extensions to main building and sheds. Connected with main railway by a spur running the entire length of the building. Engine, boiler and other machinery for shuck shelling, husk manufacturing and grist mill. Can be bought at a bargain. Real Estate Clearing House, Journal Building, Chicago, Ill.

FINE FARM in Pike county, Mo., 150 acres, all under cultivation; live stream; wire fence; wheat, corn, grain, grass; rural free delivery; frame house; good barn and outbuildings; public road on three sides. Farm implements, machinery and stock. Will sell at very low figure. Real Estate Clearing House, Journal Building, Chicago, Ill.

NEW BOOKS.

PURIFICATION OF SEWAGE AND WATER. By W. J. Dibdin. 379 pages. Price $6.50.

THE MANUFACTURE OF LAKE PIGMENTS FROM ARTIFICIAL COLORS. By Francis H. Jennison. 135 pages. Price $3.00.

TEXTILE RAW MATERIALS AND THEIR CONVERSION INTO YARNS. By Julius Zipser. 493 pages. Price $5.00.

PUBLIC LIGHTING BY GAS AND ELECTRICITY. By W. J. Dibdin. 537 pages. Price $8.00.

PRACTICAL LAWS AND DATA ON THE CONDENSATION OF STEAM IN COVERED AND BARE PIPES. By Charles P. Paulding. 102 pages. Price $2.00.

MODERN ACHIEVEMENT. By Edward Everett Hale. Size 6¼ by 9¼; 10 volumes, 450 pages each; illustrated. J. E. Fellers & Co., Chicago. Modern Achievement passes in review the great undertakings of the world within the last century and shows what steps Progress has taken and what changes, startling and revolutionary, those steps have wrought in the world's history, commercial, industrial, etc. Its truly historical pages contain much of interest to both young and old. J. E. Fellers & Co., 355 Dearborn St., Chicago, will furnish sample pages on request.

FOR SALE BY POPULAR MECHANICS

HOW TO MASSAGE THE EYE.

Thousands of readers of Popular Mechanics, who believe thoroughly in the principle of massage as a cure for bodily disease will be interested in the ingenious device known as The Ideal Sight Restorer. This very interesting device, like all successful inventions, has the merit of simplicity. It applies the principle of massage to correct refractive errors of the eye and restores that organ to a normal healthy condition by bringing about the proper circulation.

By this invention massage of the eyes is accomplished in a more perfect manner than can possibly be done by the fingers alone. The Restorer fits the eyes over the closed eyelids and is held in position by mere atmospheric pressure. With it the eyeballs are gently massaged and molded into proper or normal shape.

It is claimed for the Restorer that its daily use will correct the shape of the eye, thus curing nearsight, farsight and astigmatism. Obviously, when this condition is brought about there will be no further need of glasses. The eyes are the dearest treasures possessed by a human being. They are particularly necessary to the mechanic and to all others who are constantly using them in making their living. They are also, in many cases, shamefully neglected, the victims finding out after it is too late what a treasure they have been deprived of by their own carlessness in placing too great a strain upon them. Any invention which has for its mission the preservation of so vital an organ is always sure of careful investigation, especially if the device is built along lines of safety and simplicity, as the one referred to.—Adv.

FUN TO PULL WEEDS.

It is simply fun to pull weeds with the new weed puller that does the business in an instant and without the operator stooping over or touching the weeds with the hands. The way the weeds come up is enough to make one smile. A lady or child can operate it. Pulls up the roots, too, and it's the end of that one. This is the time to rid a lawn of all growths which do not belong there. The machine is so simple; it is very inexpensive, costing only 35 cents. Get one and your neighbors will want to join the anti-weed crusade at once. For full particulars address the Champion Weed Puller, 704 Railway Exchange building, Chicago.

BOOKS BY THE FOOT.

Not many years ago, a man who had accumulated a few million by extensive lumbering operations in the Northwest went into politics and was so liberal in supplying the campaign committee of his party with funds that he was rewarded with appointment to one of the best places at the disposal of the administration.

He went to Washington and hired a furnished mansion from a wealthy Senator whose term had expired. When he moved into the house, he found all the rooms furnished except the library. The Senator, of course, had removed his books and left the library shelves bare.

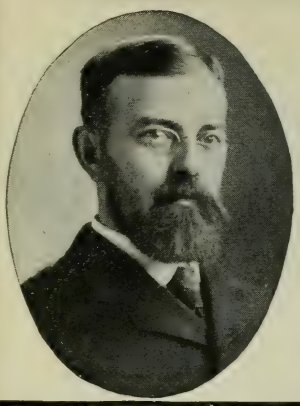
The lumberman measured the empty shelves carefully, and wired to one of his newspaper friends in New York: "Ship me a hundred sixty-seven running feet of books for library."

COLD DAY FOR LEVY.

Levy's brother died in Chicago the other day. The undertaker telegraphed to Levy: "What shall I do with the body? I can embalm it for $50 or freeze it for $30."

And Levy telegraphed back:

"Freeze it from the knees up for $20; he had his feet frozen last winter."—Lyre.



Young Man Make Money On The Side

No Experience Required
Sample Outfit Free
They cost us $25.00
Suits cost agents from $10.00 to $20.00.
Agents make 33 1-3 per cent or 50 per cent.

Biggest agent has sold $5,000 since March 1, previous to which he never had a tape in his hands

ALL GARMENTS UNION MADE. FALL SAMPLES NOW READY

JAS. F. STILES & CO.

Wholesale Tailors 293 E. Madison St., Chicago

SAMPLE COPY KANSAS OIL EDITION INVESTOR'S REVIEW **FREE**

Tells all about great opportunities to make money in this new oil field. This special number is fully illustrated and contains a vast fund of valuable, interesting and reliable information; read it before you invest a dollar. Heed its advice and you will surely become a successful investor. There are hundreds of opportunities to make big money in Kansas oil. Get posted and keep posted. Do it now, not to-morrow, BUT RIGHT NOW. ASK FOR KANSAS OIL EDITION, Just Out. Address,

INVESTOR'S REVIEW, 1461 Gaff Building, CHICAGO, ILLINOIS.

ECLIPSE POCKET AMMETER

For General Battery Testing. 0 to 20 Amperes

Flexible cord attached and contact spur in case, which is DRAWN BACK INTO CASE, when carried in pocket. Size of watch and very light weight. Can be used in any position. Particularly designed for Auto use.

PRICE $5.00

ELDREDGE ELECTRIC MFG. CO.
227 Main Street, Springfield, Mass.

THE WHITE SPARROW.

It is an old fable, about a farmer whose place was going to ruin, and who, on consulting a friend, was told that there was but one hope for him and that was to see the "white sparrow." His adviser also told him that the white sparrow was only to be seen very early in the morning. The farmer, who was rather a superstitious person, at once began to get up early every morning and look about his place, trying to find this curious bird.

The first morning he discovered that his milkmaid was in the habit of getting up very early and giving away to the neighbors, or selling for her own benefit, a bucket or two of fresh milk, after she had milked the cows. The second morning he discovered something else that was done wrong, at his expense, and so on each morning he found out some point which needed correction.

Finally after a month or so, his farm began to improve and he also began to find that he was saving many things which heretofore had been a loss to him.

His friend then asked him if he had found the white sparrow, and he replied no; that it was not necessary to find the white sparrow now, as by getting up early he had found out how to change the course of things so that his farm was already in a satisfactory condition.

It is this way with every manager. If you come late and go home early, there are many things which will escape your attention that it would be very profitable for you to know.

OYSTER RAISING IN HOLLAND.

In Holland oysters are grown in shallow pools, through which the salt water is permitted to flow freely, says an exchange. A series of these pools is called a park. The most important part of the work is done in April, when the oysters spawn. It is then that the "collectors," curved tiles about a foot long, covered with a layer of mortar, are placed in the parks. The spawn floating about in the water attaches itself to the collectors, and is then gathered into boxes 8 feet by 2 feet and immersed in the beds. In August the "collectors" are taken out for "cleaning," an operation performed by women. In the autumn they are again removed from the water, the young oysters now being the size of a 25-cent piece and strong enough to live alone. A special kind of scissors is used to take the oysters off. The tiles, with their living excrescences, are placed in the middle of a table, around which gather men and women. The latter are more dexterous than the former in performing the operation. Considerable skill is required, as there is danger of puncturing the thin shell and injuring the young oyster. Notwithstanding the care exercised, the loss is from 20 to 25 per cent.

Not yet provided with shells sufficiently strong to protect them from their numerous enemies, the oysters are then put in flat boxes with bottoms of wire netting, called "ambulances," and are covered with other boxes of the same kind. Three months later, when the oysters have attained a diameter of from two to two and a half inches and a shell thick enough to withstand the attacks of their enemies, they are strewn along the beds, to remain until they are three years old and have attained their full growth.

CO-OPERATION

is the mystic key to fortune, fame and happiness. We hold the **key**, but cannot turn it alone. We will share with **you** in the greatest **money-making** co-operative business on earth. We are **giving away 250,000 shares** of Treasury stock. Par value $1.00 per share. Not a share can be bought for cash.

There's 20 Shares for You

No more for anyone. **We don't want your money,** don't send us a cent, just a postal card. Our plan is **unlike** that of the trusts who give millions of shares to drones, called "promoters." We are giving ours to **partners**—energetic men and women. This stock will pay large dividends and costs you—just a **little** effort—**that is all**—fortune's knock is at **your** door, believe it or not, as you please.

THE PEOPLE'S COMPANY
144 West Madison Street, Chicago

ORIGINAL ROOSEVELT CLUB

Roosevelt

Fairbanks

PATENT APPLIED FOR

AND

The only Nose Glass Political Emblem yet originated. Invented by the President of the first Roosevelt Club organized in the U. S. Endorsed and recommended by the National Republican Committee.

Retails 25 cents. Discount by dozen or gross. The emblem is not only for young folks, but it is strictly high class and appropriate for ladies' and gentlemen's use. We want agents at once. Any hustler can make 100 per cent easily. All you have to do is to wear the emblem—it actually sells itself.

Sample 25 cents. Five different styles will be sent on receipt of $1.00.

CHICAGO COMMERCIAL & SPECIALTY CO., Dept. A, 528 W. 63d Street, CHICAGO, ILL.

WHY FRENCH SARDINES ARE BEST.

The reason that French sardines are superior to American is that they are packed in genuine olive oil. Robert P. Skinner, United States consul-general at Marseilles, says:

"Olive oil being too expensive to be available to American sardine packers, they are obliged to use vegetable oils, which, although excellent, fail to give to the sardine the dainty quality which the buyer enjoys. A test was made here by drying some American sardines and replacing them in olive oil. After an immersion of twenty-four hours the difference in flavor was most marked and they were pronounced to be at least equal to the French article.

A GOOD Drawing Table

CASH WITH ORDER. PRICE, $5.00

Adjustable to height and angle. Top of hard or soft wood 20 x 28 inches. Shipped in the knock-down by freight. Weight 50 lbs. Circulars free of full line of Tables.

The Hetterschied Mfg. Wks.
317 S. Division St.
GRAND RAPIDS, MICH.

THE GREAT AMERICAN TEA COMPANY

We are selling the BEST NEW CROP

50c TEAS

in the U. S.

Oolong, Eng. Breakfast, Gunpowder, Souchong, Congou, Mixed, Japan, Young Hyson, Imperial, Ceylon.

Good Oolongs, Mixed and Eng. Breakfast, 25 & 30c a lb.

We are selling the BEST

25c COFFEE

Good Roasted COFFEES, 12, 15, 18 and 20c a lb.

SPECIAL OFFER

ON a SAMPLE ORDER of $5.00 and upwards, of Teas, Coffees, Spices, Extracts and Baking Powder, we will allow you **20 per cent off and pay all express charges,** so that you may thoroughly test the quality of the goods. This is a chance that is seldom offered; it gives all a chance to purchase our goods at **less than cost.**

For full particulars and prompt attention, address

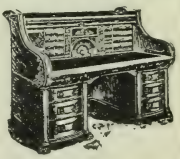
Mr. CARL, Care of

The Great American Tea Company,
31 & 33 Vesey St., P. O. Box 289, New York

IT HELPS BUSINESS

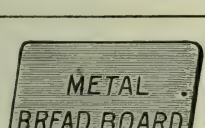
To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs



Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.
174 Wabash Ave., • • Chicago



METAL BREAD BOARD

Reversible—No wood about it. Hygienic, sanitary, low-priced. Cannot crack, split nor warp. **Lasts Forever.** Every woman wants one. Sample postpaid 25c.

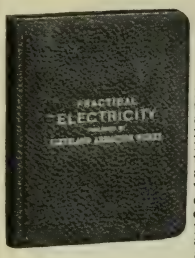
☞ Agents Wanted.

LYONS MFG. CO.,
15 Day St., PEKIN, ILL.

A CLOSE SHAVE

That is what we are giving to the price on this Razor Strop. It is not a fancy article with nickel-plated fittings, etc., but all the value is put into the leather.

An Honest Strop for an Honest Price. Sent Postpaid, 50c. Sterling Supply Co., 56 Fifth Ave., Chicago, Ill.



A School Within Itself

Space will not permit our telling you all about this book, but better still, we give you a chance to examine it for yourself by our offer to refund money if book is not satisfactory upon examination. Under this offer, 11,000 copies have been sold and paid for, and out of this number we have refunded for only fifteen copies. There are nineteen chapters, carrying you from the fundamental principles of electricity through the art to the finished dynamo. Contains a dictionary defining 1,500 words.

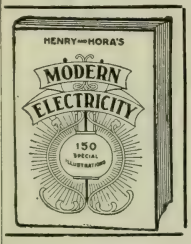
3rd Edition. Price, $2.00 delivered.

CLEVELAND ARMATURE WORKS, Cleveland, Ohio

Greatest Electrical Book

HENRY & HORA'S

Modern Electricity



A new and complete encyclopedia of this great science. Full descriptions of all electrical devices and machines, systems of transmission and distribution—every important branch of electrical science, including X-rays, wireless telegraphy, radium, etc. Devoid of theories and technical phrases. Complete cross index and appendix, 365 pages.

THE PROBLEMS OF ELECTRICITY SOLVED

An invaluable aid to the electrical engineer, workman, apprentice or student.

PRACTICAL : ACCURATE : SCIENTIFIC

Absolutely original matter prepared by expert electrical engineers, never published before.

150 ILLUSTRATIONS

drawn especially for this work.

Silk Cloth Decorative Cover, Silver Stamping, : : : $1.00
Seal Leather, Marbled Edges, Gold Stamping, : : : : 1.50

Laird & Lee's Imprint on Scientific and Mechanical Books Guarantees Reliability.

AT YOUR DEALER'S OR SENT POSTPAID ON RECEIPT OF PRICE.

LAIRD & LEE, PUBLISHERS, 263-5 Wabash Av. CHICAGO

7,000 COPIES SOLD

THE BEST BOOK to HELP YOU MAKE MORE WAGES

Written in plain language and fully illustrated.

Sipon & Chamberlan Dept. P. M. Liberty Bldg., New York FREE for $1.00

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly.

$2.00 a Year

WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.

THE MASTER OF PARAMOUNT AND HIS UNDOING.

By Walter E. Andrews.

There must be some way out of this mess," growled the colonel to himself, impatiently. "I believe the boy is innocent, and if I had only the ghost of a clew—anything to hang a thread on—I'd——"And he scowled fiercely at a bust of Blackstone over the office desk. At last he could no longer endure his own thoughts. "I'll go out and see Flora Maitland," he muttered. "I've an idea that she loves Jack. Two heads are often better than one, and perhaps she or her woman's instinct can think of something. Anyhow, I'll go."

In ten minutes he was behind a fine pair of bays, speeding out of town toward the Maitland farm. The sun shone brightly, the Michigan air was pure, and the colonel expanded his chest like an old war horse.

On sped the splendid bays, past Paramount farm with its fine house and grounds, past the orchard home where Jack Remington had lived previous to his arrest on the serious charge which now confronted him, and then a mile farther on, straight to the Maitland home. There the team stopped.

"I've come," announced the colonel to Miss Maitland, "to be cheered up. And to ask your advice about—well, about Jack." A faint tinge of color crept into her face. "I call him Jack," he softly added, "because I love him. You may call him Mr. Remington—if you wish."

For a moment she hesitated. Then, the color deepening in her face, she said simply and shyly: "Let me call him Jack, too."

"Bravo! Now we understand each other and are prepared to fight."

She gave him a puzzled look.

"You and I must fight for Jack's life and honor! We must prove that we are worthy to—to call him Jack. We must think, plan and conspire for him." His eyes seemed to burn her face. "You are a woman, with a loving woman's instinct," he continued. "I'm a plain old lawyer, with simply a faculty for reasoning—putting two and two together. But I can't jump at conclusions unless I can see some place or somebody to jump at, and I can't reason without material."

For a moment he paused. Then he added, earnestly, almost fiercely: "The prosecution bases its case on the fact that Somers spent the fateful evening at Jack's house, and that his body was found on Jack's land. We, for the defense, are working in the dark, without a contrary clew or even a suspicion. What we need is something to start on—a hint—the merest trifle pointing toward another man. But there is nothing! * * * Have you no instinctive feeling which can be of help? Does your heart give no hint to help the man you love? Think! think!"

His emotion and suppressed excitement startled her. They were old friends, but she had never seen him so moved, nor had she until that moment realized the depth of his love for Jack.

"I—I hardly know what to say," she faltered.

"Say what your instinct whispers. Who do you think could have done—what Jack never did, I'll swear?"

"Who?"

"Yes; whom do you mistrust in your own secret thoughts and your own heart? Is there anyone?"

"Yes—perhaps—I am not sure."

"Who is it?"

"Mr. Worthington," and she glanced apprehensively around the room.

"James Worthington of Paramount Farm?"

"Yes."

"Impossible!"

"Why?" Her courage returned, and she met his eyes bravely.

"Because there is no motive; Worthington is rich; and, I believe, he did not even know poor Somers."

"Perhaps—but he hates Jack."

"The dickens he does!—excuse me—why?"

"Because he—he wanted me to marry him, and I preferred—some one else," and again the color crept into her face.

This was news, indeed.

"Then why didn't Worthington kill Jack instead of Somers?" demanded the colonel, still incredulous.

"I do not know—I'm sure of nothing; I feel only an unreasoning fear and dread of him. I can't account for it, or reason it away. I feel that he has an evil heart without knowing why."

Their eyes met; the colonel became, in spite of himself, less incredulous.

It was close to four o'clock when he stepped into his buggy and turned toward home. Again the gallant bays sped over the road, but the exhilarating motion failed to arouse him from a thoughtful reverie. Nearing the great gateway leading to Paramount Farm he woke with a start, and turning into the gateway, drove up the long avenue of stately trees. But even then he muttered something about "a wild goose chase" and "women's foolish notions."

Nevertheless, he drove steadily on and soon arrived at the house. Pete came out to take the horses. Pete and the colonel were old friends.

"Master home, Pete?"

"No, sah."

"Where is he?" demanded the colonel.

"Gwine to Grand Rapids. We's all alone."

"Back soon?"

"'Bout 'leven days, sah," and the darkey grinned pleasantly.

"Well, I want a book, Pete, so I'll go into the library and help myself. Here's a quarter—catch! Now don't disturb me, for I shall want to read a little, perhaps. Take care of the horses."

Pete did catch—quite skillfully, and grinned again until his back teeth were endangered. The quarter entered his pocket and the colonel entered the house simultaneously.

The colonel had been there before, for he attended to the law business connected with Mr. Worthington's estate, and so the magnificence of the house was nothing new to him. The great hall with the stately furnishings, the luxurious parlor and the library with its long rows of books, were familiar sights. But even a stranger could have seen that the library was the master's favorite room—the place where he really lived. Every man has his own pet room, or his own pet pipe, or his own pet hobby. Mr. Worthington's hobby was evidently science, as evinced by the numerous scientific instruments and electrical appliances scattered around the library. Dust was over everything, and order there was none. Perhaps the master, being in love, had become neglectful of his old favorites; at any rate, as Peter once told the colonel in an awe-struck voice: "Massa's berry 'tickler 'bout dese t'ings—nebber let Pete dust dem or touch dem. He say dey berry dang'rous—might kill Pete!"

But, as has been indicated, this was all an old story to the colonel; and yet today somehow he seemed quite interested and courious about everything. * * * Perhaps he was nervous or restless; he could not sit still. He prowled about the room, and, in fact, over many parts of the house, hunting hunting—for what? For that book perhaps. I doubt if you had asked him, whether he could have told you more than that. As he rummaged he ruminated, and as he ruminated he swore. "A blanked, undignified old fool!" was, I think, his favorite expression at that time; all of which would have astonished Pete had he been there to see and hear. But Pete, bless his simple old heart, was rubbing down the horses and singing softly to himself in his own cheery fashion.

An hour flew by. The colonel had apparently

A Phonograph Improvement!

TIZ-IT THE NEW

/ llmetalballandsocketswiveljoint

For Reproducing and Recording.

HORN CONNECTION

A great improvement over the old connection. Soft rubber deadens the sound. TIZ-IT will increase the volume of tone, making it louder and clearer. If your dealer don't sell them, send 50cts. to J. W. Kreiling, Inventor and Manufacturer, 855 North 40th Avenue, Chicago, Ill.

The World's Headquarters for

ELECTRIC NOVELTIES and SUPPLIES

If It's Electric We Have It.—We Undersell All

Fan Motors, $2.00 to	$15.00
Battery Table Lamp,	3.00
Battery Hanging Lamp,	10.00
Telephone, complete, $2.50 to	5.95
Electric Door Bells,	1.00
Electric Carriage Lamps,	5.00
Hylo Turn-Down Lamps,	.60
$8 Medical Batteries,	3.95
$12 Belt, with Suspensary,	2 50
Telegraph Outfits,	2.00
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights, $2 to	3.50
Electric Railway,	3.25
Pocket Flash Lights,	1.25
Necktie Lights,	1.00

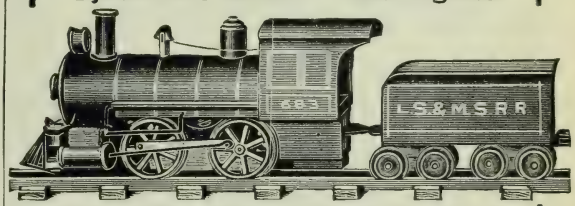
SEND FOR FREE BOOK.

$3 ElectricHand Lantern. Agents wanted.

OHIO ELECTRIC WORKS, -- Cleveland, Ohio

ELECTRIC RAILWAYS

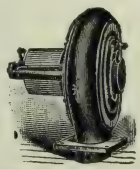
Dynamos : Motors : Gas Engines



Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio



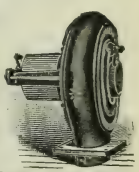
WATER MOTORS

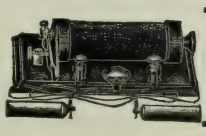
¾ to 15 H. P.

for Ice Cream Freezers, Coffee Mills, Churns, Printing Offices and small Electric Light Plants, etc.

Electric Motors and Generators, Combination Water Generator for charging storage batteries. Send stamp for circulars.

C. S. PIPER & CO., Detroit, Mich.





ELECTRIC MOTORS....65c. INDUCTION COILS.....85c. POSTPAID

Entirely new design. Send for catalog of novelties and supplies.

Artesian Electric Co. 1059 Columbia St. Chicago

$40.00 A WEEK.

Reliable man or woman each county as manager to exhibit, take orders, appoint agents for **Harrison Valveless Oil-Gas Stoves. Wonderful invention** — beats others — Automatically generates fuel gas from kerosene—**Miniature gas works**—Absolutely safe—Enormous demand—**Splendid for summer cooking**—Delight customers—Cheap, clean, safe fuel. **Gasoline is dangerous. Catalogue Free.** Write today. **WORLD MFG. CO., 568? World B'ld'g., Cincinnati, O.**

This ELEGANT Watch $3.75

Before you buy a watch cut this out and send to us with your name and address, and we will send you by express for examination a handsome **WATCH AND CHAIN C. O. D. $3.75.** Double hunting case beautifully engraved, stem wind and stem set, fitted with richly jeweled movement and guaranteed a correct timekeeper; with long Gold plated chain for Ladies or vest chain for Gents. If you consider it equal to any **$35.00 GOLD FILLED WATCH Warranted 20 YEARS** pay the express agent $3.75 and it is yours. Our 20 year guarantee sent with each watch. Mention if you want Gents' or Ladies' size. Address **H. FARBER & CO., C31, 23 Quincy St., CHICAGO.**

BE YOUR OWN BOSS

MANY MAKE $2,000 A YEAR

You have the same chance. Start a Mail Order Business at home. We tell you how. Money coming in daily. Enormous profits. Everything furnished, Write at once for our "Starter" and FREE particulars.

P. M. Krueger Co., 155 Washington St., Chicago, Ill.

MARRY WEALTH, BEAUTY. Marriage Directory FREE. Pay when married. Entirely new plan. Send no money for particulars.
SELECT CLUB, DEPT. 448, TEKONSHA, MICH.

POPULAR MECHANICS

SHOP NOTES

∴ 128 PAGES ∴
204 ILLUSTRATIONS

\- - -

Easy Ways TO DO Hard Things

\- - -

Bound in Cloth - - $1.00
Paper Covers - - - - .50

SENT POSTPAID ON RECEIPT OF PRICE

POPULAR MECHANICS
Journal Building Chicago, Illinois

found the book at last, for he came out on the veranda with his hat on his head and the precious volume under his arm. He whistled. Peter soon brought the rig around, and the colonel stepped into the buggy, calm and dignified, but strangely white.

"De co'nel read too much," said Peter to himself as he gazed after the flying team fast disappearing down the avenue; then with a shake of his woolly old head he forgot all about the subject and went singing back to his work.

* * *

The great trial was on. The prosecution had presented its evidence, and matters looked dark for the prisoner. As Colonel Walters arose—calm, impressive—there was intense silence in the room. A human life hung on his words; on his knowledge and skill. His great reputation caused some to doubt the result—but could any human skill, any human knowledge throw down the terrible mountain of evidence piled up against the prisoner? * * * The surging tide of humanity in the court-room held its breath—and waited.

Miss Maitland was there, pale, expectant, her brave, sweet eyes never leaving the prisoner's face. He, too, was pale; from long confinement, perhaps, or, as some said, perhaps from a guilty conscience. Be that as it may, his dark eyes unfalteringly met the sweet, blue eyes of the girl he loved. Did she love him? he wondered. Ah, if he only knew!

Several witnesses were called, all neighbors of the prisoner and all testifying to his previous good reputation. * * * Was that all the defense had to offer? A surprised, disappointed look passed over the faces of the spectators. The prisoner seemed to turn a shade whiter and even the colonel looked disturbed.

"Call James Worthington," he said.

A tall, gentlemanly person with piercing black eyes, irreproachably dressed, irreproachably groomed, and with an inapproachable air of distinction and wealth—and yet, somehow, not a healthy nor a happy looking gentleman—walked to the witness chair.

The colonel took him in hand listlessly. "You are the prisoner's nearest neighbor?"

"Yes."

"Has he been a good neighbor to you?"

"Yes."

"You were at home the night of the murder?"

"I was."

"Reading and studying in your library, perhaps?"

"Yes—I generally am"—with a smile.

"Just so," continued the colonel carelessly. "And the servants?"

"They were away at a dance that night."

"Then you were alone in the house"

"Yes."

"Were you acquainted with John Somers?"

"No."

"If he left Mr. Remington's farm that night and started for town, he must have passed your home some time during the evening?"

"If he did—yes!"

"And you saw nothing of him?"

"Certainly not."

The colonel looked bored and seemed about to drop the subject as hopeless. But after a moment's careless hesitation, he continued:

"You formerly lived in England, I believe?"

"I did—several years ago."

"In what part of England?"

"Birmingham."

"So did John Somers," said the colonel. Judge and jury looked surprised. Mr. Worthington no longer smiled.

"You are interested in scientific matters?" continued the colonel indifferently.

"Somewhat."

"You have telephones, X-ray machines, phonographs,

electric batteries, and other such things in your library?—I am something of an experimenter myself, and I can appreciate your tastes," added the colonel genially.

"Yes, I have such things—what of it?" and the smile reappeared.

"Nothing much, except that I'd like to make a little experiment now—with your assistance and the court's permission." So saying, he walked to a table and, quietly removing a cloth, exposed to view a large-size phonograph fitted with an exhibition sound amplifier. Then his careless manner instantly vanished, and, as he straightened up to his full height, the witness, the court and the jury were alike thrilled wtih surprise and an unaccountable feeling of—awe.

"Gentlemen!" rang out the colonel's voice, "it has been said that nothing but a miracle can save my client. I shall now call upon science for that miracle. * * * The cylinder in this phonograph is one taken from a similar machine in Mr. James Worthington's library. The cylinder was there the night of the murder; the recording apparatus of which it was then a part stood on a table; only a touch and a voice were lacking.

"Mr. Worthington, also, was there that night—as he has told you. But alone? No! A gentleman from Birmingham, England, who had been spending the evening at Jack Remington's farm, stopped on his return to town—stopped to see a scoundrel he had long been hunting and to demand vengeance for a ruined home! * * * Taken by surprise, yet ever ready, a revolver bullet was Worthington's answer, and, leaving a dying man on the library floor, the murderer fled in momentary terror. When he returned, sobered by the calm night and fortified by a villainous plan to shift the deed on a neighbor—the man who had borne the name of John Somers was dead.

"But before the unfortunate gentleman died a strange thing took place in that lonely room. * * * Sense returned for a moment—the thirst for vengeance still lived; strength revived, and—God only knows how—he raised himself to a table above him and recorded his last breath on the cylinder of the phonograph there. * * * Do you doubt it! Then listen to his dying words—you knew him—listen!"

With a quick motion the colonel touched an electric button. Through the deathlike stillness of the court-room there came creeping awful words of terror, anguish and accusation—the unmistakable voice of John Somers.

With a cry that vibrated through the building, the master of Paramount sank on the floor, and then lay still. Strangely still. The court-room was in confusion. Men shouted and swore. Women wept and fainted.

"Heart failure," said the doctors.

"Retribution!" said the awe-struck spectators.

What said the blue eyes? The brown eyes questioned and looked again. The message was there—faltering, timid, yet unmistakable. "Courage. * * * I love you. * * * All is well!"

Then court adjourned.—Philadelphia Inquirer.

MUMMY WHEAT LIKE MODERN WHEAT.

Wheat grown in Egypt 3,700 years ago was essentially the same as that grown in the United States today. Samples of Egyptian wheat taken from ancient tombs have been subjected to chemical analysis and found in every respect to be of about the same value as our wheat. In appearance the wheat was rather dark in color and when the chaff was removed the kernels showed somewhat dried and shriveled, but well-formed. The total ash elements, the amount of proteid matter, its caloric value, and even the starch grains in form and structure were about the same as in modern wheat.

Germinating tests were made with these ancient kernels, but none showed any activity of the germ.

RHEUMATISM

Drawn Out Through the Feet

Poisons Quickly Absorbed by Magic Foot Drafts Through Pores Now Opened Wide by Summer Heat

A DOLLAR PAIR FREE

On approval to any sufferer. Write.

Don't neglect Rheumatism. It is a blood disease that grows worse by neglect, causing the deposit of rheumatic poisons in the joints and muscles, producing intense suffering and deformity. The human body has 28 miles of drainage, including 8 miles of sweat tubes; and through the large pores of the feet and their capillaries the whole blood supply can be reached and purified by absorption. Magic Foot Drafts cure Rheumatism, either chronic or acute, in any part of the body, by drawing out and absorbing the rheumatic poisons from the blood.

If you have rheumatism, don't take medicine, but send at once for a pair of Magic Foot Drafts on approval. They will be sent you prepaid by return mail. If you are satisfied with the relief they bring you, send us one dollar. If not, send us nothing. You decide after trying them. Our new illustrated book on rheumatism sent free with the Drafts. Magic Foot Draft Co., 951 Oliver Building, Jackson, Mich. Write us—Today.

If It's In Print..

Any Book, Newspaper or Periodical in the World.

We Can Get It.

CHAS. McDONALD & CO.

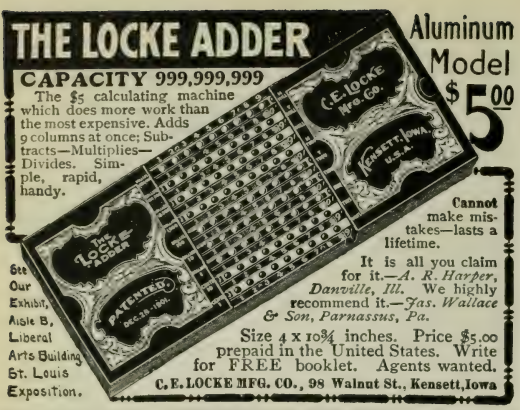
83 Washington Street

CHICAGO

THE LOCKE ADDER — Aluminum Model — $5.00

CAPACITY 999,999,999

The $5 calculating machine which does more work than the most expensive. Adds 9 columns at once; Subtracts—Multiplies—Divides. Simple, rapid, handy.



Cannot make mistakes—lasts a lifetime.

It is all you claim for it.—*A. R. Harper, Danville, Ill.* We highly recommend it.—*Jas. Wallace & Son, Parnassus, Pa.*

Size 4 x 10¾ inches. Price $5.00 prepaid in the United States. Write for FREE booklet. Agents wanted.

C. E. LOCKE MFG. CO., 98 Walnut St., Kensett, Iowa

See Our Exhibit, Aisle B, Liberal Arts Building St. Louis Exposition.

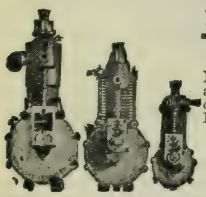
SPROCKETS

and EQUALIZING GEARS

IN STOCK OR TO ORDER.

Standard makes of Chain on hand. Prompt delivery.....Catalogue free.

CULLMAN WHEEL CO., 522 Larrabee St., Chicago



1 3-4 H. P. Bike Motor $7.50

Castings with Drawings 1904 Model

Now is the time to make that motocycle and be ready to ride when warm weather comes. 1 3-4 and 2 1-2 H. P. castings, new 1904 improved models now ready. Send for circular to

EUREKA MFG. & SUPPLY CO.
ST. PAUL, MINN.

AUTOMOBILE PARTS

OF EVERY DESCRIPTION.

Write for Catalog and Prices.

OTTO KONIGSLOW,
CLEVELAND, OHIO

SUPPLIES
DIRT CHEAP

Write for Catalogue and Green Discount

THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago

A MOTOR-CYCLE AT SMALL COST

By using one of our Attachable Outfits. THOROUGHLY PRACTICAL. In USE FOUR YEARS. Also a complete line of Motors, Castings and Accessories for Bicycle, Automobile Marine or Stationary.

Send stamp for Catalogue.

STEFFEY MFG. CO.
Brown and Pnenock Sts., Philadelphia, Pa.

THERMO-PILES

1½ Volts — 1½ Amperes

For Electrolytic Analysis, Charging Storage Batteries, Driving Small Motors, Etc. No chemicals, no smell. **$3.00 EACH.**

WALSH'S SONS & CO., 261 Washington St., Newark, N.J.

CIVILIZATION.

In his home beyond the sea,
A Jap donned trousers gay,
In the place of robes de nuit,
Which he used to wear all day.
Then he learned to shoot with skill,
And the Powers, much surprised,
Watched his bullets maim and kill,
And remarked: "He's civilized."

On the shores of Baffin's Bay,
Lived a little Esquimau,
Who made up her mind one day
To be otherwise—and so
She squeezed her pretty waist
In some corsets, undersized,
Which she then securely laced,
And remarked: "I'm civilized."

By a tropic mountainside,
A Zulu cursed his fate,
Then assumed a foreign stride
And imbibed some whiskey straight,
He put on a narrow shoe
And he never exercised,
So he got dyspepsia, too,
And remarked: "I'm civilized."

By the ancient Chinese wall,
Once a Manchu ran a race
With a Russian cannon ball,
And collided face to face
With a bombshell Japanese,
By which he was capsized;
And his friends (ascending trees)
All remarked: "He's civilized."

T. Ybarra.

MOTOR CAR WAS FIERCE.

The following recently appeared in a little weekly paper, published in a small town in Ireland, says the Dublin Motor News. It seems motor car tourists had just taken a notion to travel that way, and this is how they looked to the editor:

"The cloud no bigger than a man's hand now will develop into a raging tempest. Then let him that heeds flee to the mountains where petrol stations are not, and woe to him that hath a puncture in those days. For following close on the heel of the cloven hoof now appears Beelzebub himself,

A hundred horse-power,
A hundred miles per hour,
The hooter hooting,
The people scooting,

scattering fumes of petrol and methylated spirit, and with the moving beam of a searchlight, deadly as eye of basilisk that killeth at a distance."

BIG PAY FOR BOY'S PERILOUS WORK.

A boy in Dayton, O., is earning $4.75 every day carrying a water pail for the workmen erecting a skyscraper. More than 100 feet above the street he runs about on the slender iron beams with the pail and cup, to refresh the men. The other day he met a workman on the same beam. This beam was probably not more than six inches wide, and the water boy stopped long enough for the workman to take a drink. The two stood poised in the air 100 feet or more from the paved street, and when the workman finished his drink, the water boy backed up from the way he had come, while the workman advanced, and when they reached a point where they could pass, the workman went on to another part of the building. The water boy tripped gaily along, running and sometimes almost sliding from one upright to another, with nothing under him but a six-inch foothold to save him from a terrible fall.

Chemistry
SPELLS
Economy

CHEMISTRY has become a necessity not only to the manufacturer, but also to everyone directly or otherwise interested in manufacturing industries. There is no branch of human endeavor in which a chemist cannot help you. We can analyze and tell you how to duplicate and save money in the manufacture of any preparation on the market. Tell us your troubles and we will help you.

We have the best equipped laboratories in Chicago for general chemical work.

The analysis of lubricating oils, fuel, boilers, compounds, etc., is a specialty of ours.

THE ELLSWORTH LABORATORIES, **357 Dearborn Street, Chicago**

Our New **FLASH BOILER**

For 1904

No burning of boiler—No water gas—No smoke
Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

Condensers, and other appliances are marvels of mechanical development.

Barton Boiler Company
SOLE MANUFACTURERS,
4230 State St., Chicago, Ill., U. S. A.

Write for full particulars

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.
153 to 159 S. Clinton St.,
CHICAGO

COOLEY COLT CALF AND COW WEANER

The Only Successful Weaner in the World

Guaranteed Not to Make the Nose Sore

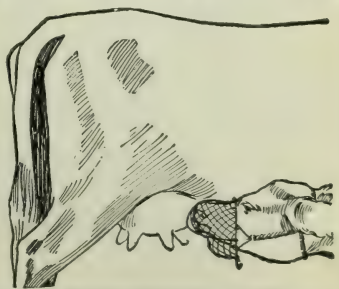
Guaranteed to keep any cow from milking herself, no matter how much she has been spoiled by other means, or whether she lies down or stands up.

No. 0 for Calf or Colt 1 day to 4 months old, with Halters, complete..... 35c
No. 1 for Small Calf or Colt 1 day to 12 months old, with Halters, complete 50c
No. 2 for 2-year-old or Jersey Cow, with Halters.. 65c
No. 3 for big Cow or Horse, with Halters..... 75c

The two small sizes are the best and handiest dog muzzles. Sent express prepaid on receipt of price.

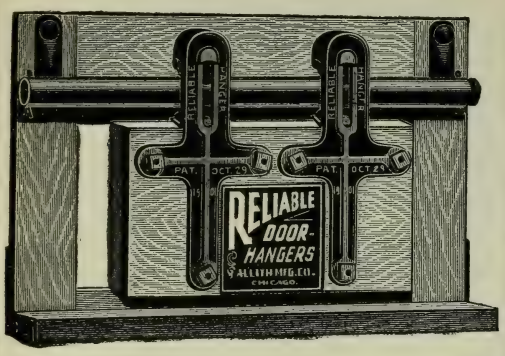
COOLEY & RANDEGGER MFG. CO.
103 South Canal St. **CHICACO, U. S. A.**

Position while eating



Position while trying to suck

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks
Ours Will Not Bind
Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.
120 South Green Street, Chicago

SOMETHING NEW

A book giving dimensions of

Pipe Fittings and Valves

Over 50 tables and many illustrations of all kinds of articles that the draftsmen and architects may need in laying out pipe work on drawings.

Flexible Backs. Good Paper. Postpaid, 50c

ADDRESS

THE DRAFTSMAN
Cleveland, Ohio

WHY FREIGHT TRAINS BREAK IN TWO.

One of the things the present day freight crew have to watch most carefully is to see that the train, often more than half a mile in length, does not part. The rear portion thus left to itself may either run away down a grade and go into the ditch, or may collide with some other train following or standing on the same track. It was one part of such a broken train which caused the terrible accident near Chicago last month.

The causes of trains thus parting are due largely to the present method of handling freight trains. in order to reduce the number of engines and train crews, trains are made up of from 40 to even 80 cars, where a few years ago they were only 20 to 30 cars. The longer the train the greater strain on the drawbars of the cars nearest the engine. Many of the cars still in use were built 15 years ago, while the locomotives have constantly grown in weight and power, having increased from 50 and 60-ton engines to 90 tons up to 110 tons.

In making up his train the yardmaster endeavors to get the old cars at the rear end, but cannot always do so.

M. V. Quinn, conductor, in a paper before the St. Louis Railway Club, said:

"I find to release the brakes at slow speed without the proper resistance on the engine or head cars will also cause train to part, the air releasing on head car first and causing head end of train to jerk rear end and very frequently pull out drawbar on break knuckle. To overcome this, all engines in road service should be equipped with retaining valves which should be used while releasing at slow speed. In case engines are not so equipped and are required to slow down to a speed of eight miles per hour, the train should be brought to a full stop, or the trainmen should set up four or five retainers on head end of train, or at least set four or five hand brakes, which will keep train bunched until air releases on rear end of train."

The train pulls apart by reason of the draft rigging pulling out of the car, or because some part of the automatic coupler breaks or fails to hold while going round a curve.

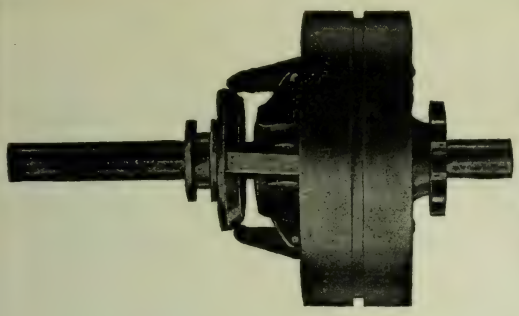
The time required for a long train to pick up a single car at a way station and set it near the rear of the train is from 30 to 45 minutes, hence the temptation to set it near the engine which saves fully half the time, but if it happens to be an old car increases the risk.

MOTOR BOATS WILL BE FAST.

Jellinect, a noted German authority on motorboats, says: "I am quite sure that within a few years motor boats will be built which will be speedier than our fast automobiles. It is true some have claimed the power of resistance of the water is so great that it will not be possible to make boats to go so fast as motor cars. Well, the same argument was used for years in the discussion as to the probable limit of speed of ocean greyhounds; they tried to demonstrate with figures that they would not be able to travel faster than 19 miles per hour. At present some have shown a speed of nearly 27 miles. So you can draw your own conclusions as to the possibilities for speed in motor boats."

A WESTERN EPITAPH.

Here lies the form of Ezra Hurst,
An Indian cut his hair;—
Cut his hair off, bottom first—
'Twas more than Ez could bare.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

Successors to THE P. J. DASEY CO.

339 Michigan Blvd. Chicago, Ill., U. S. A.

CRANE VALVES

ESTABLISHED 1855

VALUABLE INFORMATION FOR

Expert and Amateur Machinists

WHO ARE NOW USING TOOLS

You may have free our complete Catalogue of Fine Tools. Fully illustrated, 176 pages. Gives useful information about all the new Mechanical Tools.

Every tool we make is warranted Accurate and satisfactory.

Ask for Catalogue No. 17 A. P. and send us your address.

THE L. S. STARRETT CO., - - Athol, Mass.

WE CAN MANUFACTURE ANYTHING IN

Brass, Aluminum, Phosphor-Bronze or Gun Metal

We also manufacture Refrigerators, Beer Pumps, Faucets and Supplies.

Our Prices are reasonable. Write us.

U. S. SPECIALTY MFG. CO., - 33 Washington St., Chicago

If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

POPULAR MECHANICS CO.

---- ACETYLENE SEARCHLIGHT ----

FOR YOUR YACHT

A neat, compact, self-generating, portable Searchlight of high power for power and sailing yachts. A necessity and ornament to every yacht. Useful in locating buoys, making landings, detecting obstructions, etc. Should be part of every yacht's equipment.

WRITE TODAY FOR CATALOG

AMERICAN ACETYLENE STOVE CO., 506 Masonic Temple, Minneapolis, Minn.

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building - - WASHINGTON, D. C.

SPECIAL MANUFACTURING
Dies and Stamping
--TO ORDER--
SPECIAL MACHINERY, MODELS
EXPERIMENTAL WORK
DROP FORGING DIES AND DROP FORGINGS
Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.
THE GLOBE MACHINE & STAMPING CO.
973 Hamilton St., - Cleveland, Ohio

W. X. Stevens
(Estab. 1867)
Solicitor of American and Foreign
PATENTS
Honest advice; honest service. My record—97 per cent. successful cases. Booklet free.
1065 Virginia Ave. -- WASHINGTON. D.C.

MODELS CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE
ESTABLISHED 1867 OF MODEL SUPPLIES

Send for
POPULAR MECHANICS
PREMIUM LIST.
Just Out

SAVE MONEY
By sending to us for Blue Prints and Drawings, Model, Die and Pattern Work. Experimental Machines built to order. Write for Estimates.
FOTO MFG. CO.
General Contractors, 58 FifthAvenue, Chicago

INVENTIONS PERFECTED through designing working drawings, and superintended by MECHANICAL EXPERT of wide reputation and practical experience.
GEORGE WEISS, Mechanical Engineer, 614 Omaha Building, CHICAGO, ILLINOIS

HOW VALUABLE INVENTIONS WERE STOLEN.

The history of the conception, development and final success or loss of inventions which were worth millions, would make a stranger and more fascinating story than any romance ever penned. The Technical World says:

The scene of one of these stories is laid in the wild moorland country around Sheffield, England, where a watchmaker named Huntsman had built a factory for making steel by a process of his own invention. The secret was a very valuable one, for it was the only process by which steel could be made of uniform quality throughout; but Huntsman had little fear that any of his rivals would discover it, for he employed only picked and sworn workmen, and the portals of his factory were almost as strictly guarded against strangers as the doors of a bullion vault.

However, one bitterly cold wintry night, when the wind was shrieking over the neighboring moor, driving the snow in wild eddies before it, a tattered, shivering tramp presented himself at the door of the works and pitifully craved permission to warm his frozen bones at the furnace fires. For a long time he pleaded in vain; the doorkeeper was obdurate; but finally importunity and the pathetic aspect of the man won the day, and the tramp was admitted to the warmth, only to fling himself on the floor in utter exhaustion and to fall asleep.

The rascal, however, was sleeping with one eye open, and with that eye he was craftily watching the men at their work, with the result that when an hour later he left the place with words of gratitude, he took Huntsman's secret with him.

Another interesting story takes us to the neighborhood of Temple Bar, in London, and to the shop of a chemist who was the only man in England that knew the secret of the manufacture of citric acid. So jealous was he of his invention that he would share it with no one, but worked alone in the laboratory over his shop in Fleet street.

One evening, however, when his processes were well advanced, he locked up his laboratory and left the premises for a time, assured that no one could possibly gain admittance during his absence. But he bargained without a certain uninvited guest who worked his way down the chimney into the laboratory and made such good use of his time that when he re-emerged from the chimney he had the manufacture of citric acid at his fingers' ends.

WAS SAVING THE CRACK.

Billy was operating a locomotive in the capacity of engineer and Mike was firing for him. Mike was ambitious and often looked the locomotive over to find out if anything was wrong with it. Just about Christmas one year Mike crawled down around the engine and came out, very officious, and said, "You have got a crack in your truck wheel," and the engine was taken out of service and Billy missed the run out, but he got Mike in a corner and said, "You blanked idiot, what did you go poking around that wheel for? I was saving it for Christmas for a lay-off."

CRANE FITTINGS
ESTABLISHED 1855

COWS ELECTRICALLY MILKED.

Cows are now milked at many large dairy farms in Germany by means of electricity. Rubber hoods are attached to the udder of the cow and these hoods are connected with a vessel for receiving the milk by means of a rubber tube, from which an electrical device exhausts the air. The suction so secured closely resembles the sucking of a calf and the milk flows more freely than when the milking is done by hand. Absolute cleanliness is secured where the electrical method is used.

WHERE SHELLAC COMES FROM.

Few people know that lac from which shellac is manufactured is an incrustation left on the branches of certain trees by insects in India. All Indian provinces produce it but principally the Central Provinces, Bengal and Assam. In other districts local dealers use it for making rings, beads, bracelets and other ornaments and also for wood laquer work.

The lac is collected by the jungle tribes, who break off branches on which it is deposited. In this form it is called stick lac. Manufacturers of shellac and button lac buy large quantities of it in this form and put it through the processes which prepare it for commerce. The United Kingdom and the United States are the two great markets for it.

Shellac has been used in electrical works and in making gramophone records of late and as the demand has exceeded the supply, the price is considerably higher, says Consul-General Patterscn of Calcutta, India.

AMAZON REGION THE GRAVE OF BRIGHT EXPECTATIONS.

Many fabulous stories are told of the country stretching far on either side of the Amazon, that mighty stream that flowing though a series of mouths 180 miles wide stains the ocean for a distance of 600 miles. United States Consul Aymé, of Para, Brazil, however, in a recent report refutes these stories and says that the great matted swamp forests do not contain the endless succession of valuable products imagined by many persons and that there is nothing in the region for young men of enterprising spirit and a few thousand dollars capital.

The beautiful green fields one sees on either side as he steams up the river are only wide swamps which would engulf the flocks and herds one can in fancy see upon them; there are but two real markets, Manaos and Para, on the whole length of the Amazon. The valuable woods, nuts, fruits, oils, gums which are found there occur as rarely as diamonds in gravel or gold nuggets in streams. Rubber, ebony and rosewood trees grow solitarily, and if two are found separated by only a quarter of a mile of matted swamp forest they are considered close together. No great quantity of food is produced by the forests and a river fish and starch of dried manioc root are the principal articles of diet. Terrible, devastating, comfort-destroying insects are to be dealt with; strange languages and customs, and fevers which wreck the system. Then the would-be capitalist is ready to return home with money, health, youth and energy lost.

J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing
165-167 Dearborn St. Chicago

NAME PLATES, TRADE MARKS

THE MEYERCORD CO.
DECALCOMANIA TRANSFERS
NAME PLATES, TRADE MARKS AND ORNAMENTS
OPALESCENT TRANSFER WINDOW SIGNS
CHAMBER OF COMMERCE BLDG. CHICAGO

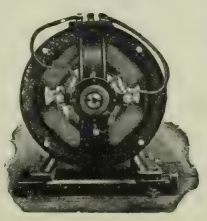
TRANSFER WINDOW SIGNS

Geo. J. Munroe
ATTORNEY AT LAW and FINANCIAL AGENT.
Companies Incorporated and financed in any State or Territory at Reasonable Rates.
Write for Particulars.
SUITES 1011, 1012 and 1013 Hartford Bldg., 140 Dearborn St., CHICAGO
Mention "Popular Mechanics" when writing.

Send three one-cent stamps for 5-color
PICTURE OF LINCOLN PARK BRIDGE
W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

MODELS AND SUPPLIES
Send for Illustrated Catalog of Appliance for Models
J. WEINERT & CO., 134 Pierce Avenue, Chicago

POPULAR MECHANICS
Cen give you the address
of the maker of any
MACHINE OR TOOL



Peerless Electric Co.
ELECTRICAL REPAIRING
RECORDING WATTMETERS
SEND FOR BARGAIN SHEET
141-143 South Clinton Street
'Phone Main 1025 Chicago

The American Well Wks.

AURORA, ILL., U. S. A.

CHICAGO, ILL. DALLAS, TEX.

For over a quarter of a century have been building WELL SINKING and PROSPECTING MACHINERY and TOOLS for ROCK and ALLUVIAL, ROTARY and CORING WORK of moderate cost, speedy economical in operation, enabling large per cent saving in pay roll and pipe bills.

This photograph may not illustrate the style of machine best suited to your work, but we have one hundred other styles and sizes some of which will. Why should we not have your orders?

We have pleased old customers, can please new ones.

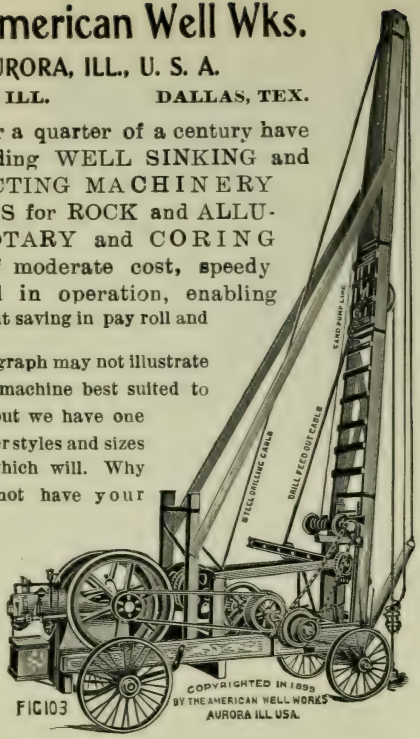


FIG 103

AUTOMATIC —PIPE— WRENCH

Strongest Simplest Best

It is self-adjusting and self-releasing. It never gains. Made in three sizes, 10-inch, $2.00; 16-inch, $2.75; 24-inch, $5.00, express prepaid.

H. P. VAN NESS

607 Northern Office Bldg., CHICAGO, ILL.

TOOTH POWDER FORMULA.

Two ounces of pulverized borax mixed with four ounces precipitated chalk, add one ounce each of powdered myrrh and pulverized orris. Sift through fine bolting cloth and bottle for use.

ANNOUNCEMENT BY POPULAR MECHANICS' PATENT BUREAU.

WHAT WE CANNOT DO:

We are frequently invited by inventors to advance money to patent and promote their inventions, and reimburse ourselves from the sale of the patents. Many of the inventions so offered are meritorious and doubtless would prove profitable commercially, but we are obliged to decline all such offers for the following reasons:

First.—It requires our time and best energies to look after the patent interests of clients who pay cash for our services. It would not be fair to such clients if we gave others like service on any terms except cash.

Second.—If we became financially interested in certain patents, such interest might conflict with that of clients who have similar inventions or patents and subject us to the suspicion of protecting or promoting our own patents at the expeuse of our clients' interests. As patent attorneys we must be free at all times to give all clients absolutely impartial advice, and the only safe way to do this is not to have a financial interest in any patent or invention.

Third.—If we accepted some of these propositions and declined others, we would offend those whose offers were refused.

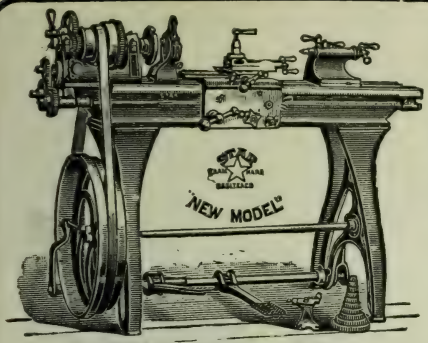
WHAT WE CAN DO:

The above offers usually come from inventors who are not financially able to obtain patents and develop their ideas commercially. At an expense of $10 inventors can nearly always place themselves in position to obtain the money necessary to patent their inventions and get them before the public. In almost every community there are business men who will advance the cash to patent and promote a good invention if they are given an interest in the patent, but they want to know that the invention is patentable and that it is likely to be practical and profitable. To find out whether an invention is patentable it is necessary to examine the patent records and see if it has ever been patented. The expense of doing this is $5.

An inexpensive test of the practicability of an invention is to have a good drawing made of it by a skilled draftsman. We can do this for you at an expense of $5, and the drawing can afterwards be used in applying for a patent, thus saving that amount on the cost of the patent. With our report showing that the invention is practical and patentable, an inventor can go to any one with a business-like proposition, and there are few communities where he will be unable to raise the money necessary to obtain a patent and make a sample or model of the invention so that it can be placed in good shape before manufacturers or others interested. Usually the drawing which we furnish is alone sufficient to prove the practicability of the idea. These steps must be taken by the inventor at his own expense if he wishes to secure financial assistance for the patent and other expenses. If the inventor has not $10 worth of confidence in his own invention he should not expect others to invest a greater amount in it.

We are always glad to help inventors in connection with their inventions in every legitimate way. In meritorious cases we have paid inventors a commission on patent business of others which they have been instrumental in getting for us, and these commissions have enabled them to apply for their own patents. All that is necessary to earn this commission, is to send us the names and addresses of inventors, and when we obtain their patent cases we will credit 20 per cent of our fees to the party who furnishes the information.

From the above, it will be seen that any inventor who is really in earnest about getting a patent can by expending ten dollars, and the exercise



9 and 11-inch "Star" Foot Lathes.
9, 11, 12 and 14-inch "Star" Power Lathes

STAR LATHES Foot and Power...

High-grade screw-cutting engine Lathes, with forged crucible steel hollow spindles, phosphor bronze bearings, gear-driven reversible feeds with strong friction drive in apron, our patented spring nuts which allow quick shifts of change gears, also Draw-in Chuck, Gear-cutting, Milling and Taper Attachments if desired.

Suitable for electrical and repair work, model makers, gunsmiths, technical schools and fine, accurate machine-shop and tool-room service. Ask for COMPLETE DESCRIPTIONS.

THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N. Y., U. S. A.

of energy and persistence, obtain the money required to patent and promote his invention.

The successful inventors are those who do these things:

A. Invent something new and useful.

B. Protect the invention by a strong patent.

C. Put the invention before the public in the best shape and manner possible.

We place 25 years of experience with patents at your disposal, and what we don't know we will find out for you if given an opportunity.

POPULAR MECHANICS PATENT BUREAU,
Frederick Benjamin, Chief of Bureau.
Main Office, Journal Bldg., Chicago, Ill.

RIDING A LOG TO ST LOUIS.

This is the year of the freak journey. We hear of notoriety seekers traveling to the world's fair on foot, in all kinds of land conveyances, in skiffs, houseboats, and other water crafts, one man in St. Paul proposes to swim from that city to the world's fair city, while still another thinks he can walk on the river bed from La Crosse to the fair. But now comes the man with yet another plan.

John McCaffery proposes to start from Keokuk and make the trip to the world's fair standing upright on a log with nothing but a pike pole to assist in maintaining his position. McCaffery is 54 years of age, and is an expert employed in one of the Keokuk lumber mills. He declares he is equal to the unique trip. He figures it out that he can go from Keokuk to St. Louis in 52 hours, as the river runs about four miles an hour. The sight of a man riding down stream on a rolling, swaying log will be a novel one.

A JAPANESE GARDENER'S WISDOM.

The late Sir Edward Arnold, whose wife was a Japanese girl, told many stories of the people of the Orient, says Collier's Weekly.

"The Japanese gardeners," he once said, "have carried their art further than we have carried ours. A landscape gardener in Japan is esteemed highly. He is looked upon quite as we look on a poet or a painter.

"And these Japanese gardeners are, truly, remarkable men. I was riding with one of them near Kioto on an August afternoon and we came to a steep hillside.

" 'Tell me,' I said, 'how would you plan a road to the top of that difficult hill?'

"The gardener smiled humorously.

"'I think,' he said, 'that I would first turn some cows loose and see how they get up.' "

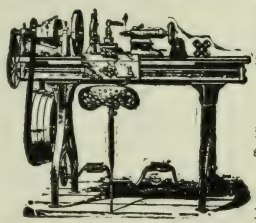
The Grant artesian well, near Sioux Falls, S. D., throws out fish about two inches in length. The well is 850 feet deep, and the fact that the fish are not blind indicates that they came from surface water.

FOOT and POWER

AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.

A131 W. 2d St., Cincinnati, Ohio



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

WHILE - THEY - LAST

8, 9, 10 and 12 HACK SAW BLADES

30c. Per Doz. $3 Per Gross

SAMUEL HARRIS & CO., 23-25 S. Clinton St., Chicago

Fire It Right Back

AT OUR EXPENSE

That's what you want to do if you can find any fault with our new Dust Proof 2¾ H. P. Engine. We are making a Specialty of this one size Gasoline Engine and build nothing else.

They are designed right to start with, and then built so they will last even under severe service. Our price is $138.00, complete and ready to run when delivered.

Get Our "Money Back" Offer

McNAUGHTON-BASSETT CO. Charlotte, Mich.

WE BUILD GASOLINE ENGINES

Automobile, Marine and Stationary

Transmission, Gears, Carburetters, Pumps, Mufflers, &c.

Write for circular and prices before ordering

W. B. MURRAY, 1253 Milwaukee Avenue, Chicago

AN INCOME FOR LIFE

I will send you **free,** booklet telling how to make $1 earn $10, larger amounts in proportion. A few of your idle dollars invested will bring an income for life. Send no money, booklet is free. Just a few left. Address

J. B. LAWRENCE, 112 Michigan Street, CHICAGO

Common Red Clover

Cures Cancer, Eczema, Salt-Rheum, Rheumatism and all other Blood Diseases

How many people realize the true value of our common red clover? It is the best blood purifier known. Thousands of prominent people have been cured of cancer, rheumatism, constipation, eczema, skin and blood diseases by its use. Send your address to D. Needham's Sons, 116c Lakeside Bldg., Chicago, Ill., and they will mail free a full description of Red Clover Blossom Extract, a history of how Mr. Needham cured his cancer and testimonials from many who have used the remedy. If you have any disorder of the blood look into the merits of Needham's Clover. It is the best blood purifier known.

INDUSTRY

MAGAZINE for August contains "How I Got My Automobile and Made It Pay for Itself." YOU can do likewise. How to make an Electric Telephone for fifty cents. A Valveless Gasoline Engine for automobile, boat or power, illustrated. A miniature Water Power Electric Plant. Electrical Firecrackers, and many other valuable articles, formulas, hints and helps for Mechanics, Amateurs, Students, Teachers and Business Men. Every number full of helpful PRACTICAL information. How to make Electrical Machinery and Apparatus, Gas and Steam Engines, Boats, Launches, Traps, Camps, etc. We furnish complete working drawings and instructions. Also articles on Mining, Technology, Manufacturing, etc. Fifty cents per year.

Three months' trial, 10 cents. SPECIAL OFFER to new subscribers—For fifty cents, Industry Magazine 17 months and a 64-page illustrated book on toy and model making worth the whole price. See our $500 "Hit or Miss" Prize offer in July number. You can enter this contest, open to every subscriber. Send your subscription at once. **INDUSTRY MAGAZINE,** Box P. M., Fairfield, Maine.

WINTER CLOTHING OFFER.

FREE SAMPLE AND TRIAL PROPOSITION.

If you would have any use for a heavy or medium weight all wool **Suit, Overcoat or Ulster,** then **DON'T BUY ELSEWHERE** at any price, under any circumstances, until you cut this advertisement out and mail it to us. You will then receive **by return mail free, postpaid, the Grandest Clothing Offer ever heard of.** You will get **FREE** a big book of cloth samples of Men's Clothing, **FREE** an extra quality cloth tape measure (yard measure), **FREE** a book of Latest Fashions, descriptions and illustrations of all kinds of clothing for men. We will explain why we can sell at prices so much lower than were ever before known, a mere fraction of what others charge. We will explain our simple rules so you can take your own measure and how we guarantee a perfect fit. You will get our **Free Trial Offer, our Pay After Received Proposition.** With the free outfit goes a special sample order blank for ordering, return envelopes, etc., etc. You can get a **whole Suit,** an **extra pair of Pants** and an **Overcoat** under our offer for about **ONE-HALF** what some Chicago tailors would charge for **one single pair of pants.** The offer you will get will astonish and please you. Prices on the best clothes made reduced to next to nothing compared with what you have been paying. **DON'T BUY CLOTHES** until you cut this ad. out and send to us, and see what you get by return mail, **free, postpaid.** Address, **SEARS, ROEBUCK & CO.** CHICAGO, ILL.

I SELL

PATENTS

on hardware or mail-order specialties, machinery, anything. If you wish to buy or lease them on royalty write me.

INVENTORS

desirous of selling their patents quickly and to the best advantage should register with me. I save you time and money.

CHAS. A. SCOTT
796 Mutual Life Building
BUFFALO, New York

MID-YEAR TRADE PROSPECTS.

While marked with the conservatism that always accompanies the presidential campaign, trade conditions at the mid-year stage are much more favorable than they were at the beginning of the year. The great factors entering into their fluctuations have been the Baltimore fire, a late spring, labor disturbances, the sound financial conditions now prevalent, the World's Fair and the campaign. As usual the rise and fall of hope have depended on the farmers. The outlook for crops is now fine and at this late day is not liable to any serious change. In speaking of trade prospects The Keystone says:

"It is generally believed that business among both the wholesale and retail branches of the jewelry and optical trades for the first six months of the year will not equal in volume that of the first half of 1903. These trades, like all other lines, have felt the conservatism due to campaign and World's Fair year, but the falling off has been but slight. Crop prospects are good in the west. From the northern extreme of Chicago's territory down to the farthest south, there is scarcely a spot that is suffering in any degree. Collections are doing fairly well, considering the season."

Other papers confirm this hopeful opinion. The Lumber Review mentions the disturbing element of campaign year and further says: "The volume of business in the lumber trade this year has not been entirely satisfactory in any line of stock, but there are now indications that the tide is turning and that the business of the fall months will be equal to that during the fall months of last year. An average crop of all sorts is now assured and the financial market is easy."

The Iron Age says that for the iron and steel industries the past half year was big in the middle and little at both ends. In the beginning trade was depressed and the depression was widely felt. Then it picked up and prices advanced; then again, through May and June, orders were short and workmen idle. These latter occurrences, it says, are generally regarded as results of the past rather than symptoms of coming depression and adds:

"Favorable crop reports are largely given the credit for this display of cheerfulness, but the cause lies deeper than crop reports. Money is so abundant that interest rates are lower than they have been for a decade; security values are hardening instead of falling, and the investment demand for bonds and high grade stocks has for some time been steadily increasing. With the subsidence of the fear of financial disturbances, confidence in better business conditions is a natural sequence, especially when a good crop prospect offers itself as a substantial basis for expecting railroads to be favored with their usual traffic, not alone in moving crops, but in transporting other merchandise to supply the wants of prosperous agriculturists. Here rests the hope of the future."

Learn Bookkeeping Free

Would you like to succeed in business, to obtain a good paying position; to secure an increase in salary? Would you possess the capacity that directs and controls large business enterprises? If so, you should follow the example of Mr. Edw. Chapman, of No. 606 So. 5th St., Goshen, Ind., who largely increased his salary after taking our course. A knowledge of accounts increases your opportunities a hundred fold. Our method excels all others. You can learn quickly at home, without loss of time or money. We guarantee it.

A GREAT BOOK FREE

"HOW TO SUCCEED IN BUSINESS" is the title of an extensive treatise on Bookkeeping and Business. It tells of the best system of accounts ever devised, and explains how you can make more money and better your position in life. It is just the book for beginners and experts alike. To advertise our system we will give away 5,000 copies absolutely free, without any condition whatever. Simply send your name and address and receive the book without cost. Address

Commercial Correspondence Schools
147 L, Com'l. Bldg. , Rochester, N.Y.

We Teach You FREE: We Secure A Position For You.

The Furniture Journal says that with the prospect of good crops and no financial disturbances trade will grow in volume as the end of the year is approached and that buyers, though not now placing their orders with great freedom, are making much memoranda for the fall buying; that prices have been reasonably well maintained and that each day has added to the confidence that there will be a fairly satisfactory business during the remainder of the year.

"The outlook for steel ranges for the coming year is about as good as it has been heretofore," says the Hardware Record, and adds: "Of course, trade conditions are not as favorable as they have been and the steel range business suffers its percentage. In spite of this, however, there appear to be new steel range manufacturers springing up every month."

"New York trade is dull," says The Presto, "but it is a natural annual condition beginning about July 1st and ending about September 1st," and also says that the piano trade suffers at that time because people who can afford to buy pianos spend those months at some of the nearby seashore or mountain resorts. Western piano trade has been quieter than last summer, but by no means dull. Active fall trade is expected and the piano player business flourishes. Good foundations for fall trade have been laid during the summer months.

The Railway Review declares that "the dullness everywhere prevailing in the steel industry is due to the general slowing down in all lines dependent on iron and steel production," and further says that "the present home outlook is for a period of comparative depression in the steel industry, which will continue until the great buying and consuming interests see their way clear to expand facilities and means of production."

STEVENS

The kind of firearm to obtain is a weapon that is **guaranteed** for **quality** and has a **record** of **achievement.** When leading sportsmen the world over use the "STEVENS" in preference to other makes, it simply means that our line of **rifles, pistols** and **shotguns,** *exactly suits in every particular.*

Ask your dealer, and insist on the STEVENS. If you cannot obtain them, we will ship EXPRESS PREPAID, upon receipt of catalog price.

Our illustrated catalog of 136 pages embodies our entire line and describes some recent notable additions. Mailed for 4 cents to cover postage.

J. STEVENS ARMS & TOOL CO.
40 Main Street
Chicopee Falls Massachusetts

"IF SLEEPING, WAKE,

If feasting, RISE before I turn away." It is the hour of FATE 'Tis

OPPORTUNITY

the ruler of human destinies, that speaks
Of many books there's ONE YOU NEED
'Tis unpretentious, and its name?

"A Guide to Full Pockets"

That's what most mortals need and if thy needs are common with the rest, **here** is the mystic key to **fortune, fame and joy.**
'Tis FREE, for fortune's smiles can ne'er be bought. Thousands have read and quickly grasped the offered boon. **'Tis now thy turn**—this call the **last** to **you.** If heeded not you'll seek in vain for that which will return no more. Send thou a postal card and we will tell thee all.

THE NUTRIOLA CO., 142 W. Madison St., Chicago, Ill.

"Twin Lever" Motorette

EARN EASY MONEY

Make your own Automobile to sell or rent. Beside exhilarating fun for yourself you can earn the price back soon. Safest, best and cheapest. Gives health, fun and money. What more do you want?

Motorette Mfg. Co.
W. PULLMAN, ILL.

WANT A MAGAZINE? We print it for you—$2.50 a month. 100,000 circulation. Big money in it. Best way to advertise. Plan and sample 10c. A. C. PHILLIPS, 506 Pontiac Bldg., Chicago

GET GOOD INVESTMENTS

LEST BAD INVESTMENTS GET YOU.

OPPORTUNITY

It is said "that fortune knocks once at every man's door." It is even now rapping loud and distinctly at yours. Men of achievement throughout the universe attribute their success in life principally to their ability to recognize opportunity. It may be the lack of this element that retards your progress on the highway of success. Can anything be more convincing than the following testimony that your opportunity to become wealthy is here? Don't resist prosperity—Embrace the opportunity to secure this peerless investment now.

EXTRACTS FROM THE MINING EXPERTS' DECLARATIONS ABOUT THE GREAT ARIZONA MINES OWNED BY THE LINCOLN CONSOLIDATED MINING COMPANY

H. B. STURTEVANT Mining Engineer for the Buffalo and Susquehanna Iron Co., states:
"$80,000 has been taken from these mines by the Mexican owners."
"Heretofore the widow of Capt. Garcia has refused all offers to purchase them."
"There are 8 or 10 fissure veins, containing copper (higher sulphides), gold, silver, lead and iron oxides,"
"There are perfect economic smelting conditions."
"Any one of the five groups mentioned herein is sufficiently good for the whole capitalization of the company."

F. W. FICKETT, M. S., declares:
"I have personally examined the properties of the LINCOLN CONSOLIDATED MINING COMPANY."
"I consider Engineer Sturtevant's report a fair and conservative one."
"I doubt if another property in Arizona promises such returns for the money invested."

INDUSTRIAL AGE. July 28, 1904, announces:

"TITLE TO LINCOLN CONSOLIDATED MINES"

"Tucson, Ariz., July 3, 1904.—Deeds and title papers to the Lincoln Consolidated group of mines have been filed for record in Tucson, conveying the absolute title, free of incumbrance, to that corporation. There are 31 of these claims, about 700 acres One group is more than a mile square and covers an entire mineralized mountain, where the ore in many places is rich enough to ship to the smelter from the very grass roots at a profit. The people of Tucson expect much from the operation of this property."

Call or write for particulars, it will be laying the corner-stone in the building of your fortune

The W. B. KIRTLAND CO.

Fiscal Agents, 153-155 La Salle St. CHICAGO, ILL.

Did you read our Ad. in the August number of this magazine ?

WATERWAYS AID AUSTRIA'S COMMERCE.

In view of the increased interest being taken in interior waterways in the United States, it is well to point to the splendid success that Austria is experiencing in a similar ambition. In 1901 a law was passed providing $50,000,000 for the commencement of a network of navigable canals and river improvements in Austria. This amount was expected to cover the cost up to 1912, when a new credit will be required. So successful has been the beginning of the enterprise that now it is proposed to build a system of navigable canals extending over the Dual Monarchy and to bring Fiume, the only seaport in Hungary, into direct connection with the river system of the country, by aid of a canal between the Danube and the Sava.

Since the beginning of the improvements the river traffic in Austria has been steadily on the increase. On the Danube the average tonnage rose from 315,930 tons in 1890 to over 1,503,165 tons in 1900. In Hungary the traffic has increased from 2½ million tons in 1888 to 3¾ million tons in 1901.

The national system of railways has proceeded side by side with the increased facilities for navigation.

A Parisian street advertising scheme whereby hairless men expose their bald pates with advertisements painted thereon has met with a setback. Government stamp must be punched on all such ads, and the heads must also bear the union label, which fastens with two tacks.

Telegraphy taught thoroughly. Institution established 1874

Endorsed by officials Railroads and W. U. Tel. Co. Positions secured. **Entire cost**, tuition (telegraphy and typewriting, board and room, **6 Mos. course, $89. Can be reduced.** Home instruction also given. Catalogue W free.

Dodge's Institute of Telegraphy, - - Valparaiso, Ind.

PEANUTS and POP CORN

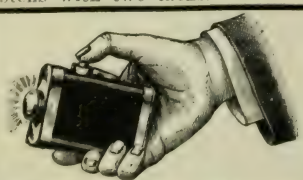
A BUSINESS THAT PAYS

Machines are earning from $35 to $60 per week. Catalog Free.

S. DUNBAR & CO.

18 & 20 No. Desplaines St.

CHICAGO



THE RELIABLE

ELECTRIC VEST POCKET LIGHT

IF you wish to find a house number at night; if you wish to find an article you have dropped; if you wish to avoid dangerous places in dark streets, just "press the button" and you have an instant, brilliant light. Will give eight thousand flashes, or burn three months with right usage. Inexpensive to buy and to operate! Invaluable to physicians, or miners and gasfitters who go in dark places where any other form of light is dangerous. Batteries and bulbs easily detached and renewed when required.

$1.00—Complete—$1.00 Postage 10c extra. Extra batteries 30c. Extra bulbs 35c.

Write for prices in quantities and complete catalog Agents wanted. HOWARD ELECTRICAL NOVELTY CO., 183 Lake St., Chicago.

The Open Court

AN ILLUSTRATED MONTHLY MAGAZINE

Devoted to the Science of Religion, The Religion of Science and the Extension of the Religious Parliament Idea.

10 cents per copy - - - - - - $1.00 per year

SCIENCE is slowly but surely transforming the world. Science is knowledge verified; it is Truth proved; and Truth will always conquer in the end. The power of Science is irresistible. Science is the still small voice; it is not profane, it is sacred; it is not human, it is superhuman; Science is a divine revelation.

Convinced of the religious significance of Science, *The Open Court* believes that there is a holiness in scientific truth which is not as yet recognized in its full significance either by scientists or religious leaders. The scientific spirit, if it but be a genuine devotion to Truth, contains a remedy for many ills; it leads the way of conservative progress and comes not to destroy but to fulfil.

The Open Court on the one hand is devoted to the *Science of Religion;* it investigates the religious problems in the domain of philosophy, psychology, and history; and on the other hand advocates the *Religion of Science.* It believes that Science can work out a reform within the Churches that will preserve of religion all that is true, and good, and wholesome. Sample copies of *The Open Court* sent on request together with illustrated catalogue of important publications for the Study of Religion. Published by

THE OPEN COURT PUBLISHING COMPANY, 326 Dearborn St., Chicago.

THE TWO BEARS.

By H. B. W.

Of all the steps in life we take
  There's surely none involves
So many things to plan and make,
  So many good resolves,
As when we give our heart away,
  To one we hold most dear,
And promise on some future day,
  Without a doubt or fear,
To walk with him the path of life
  And be his true and loving wife.

Our friends they come with smiling look,
  And wish us every joy,
Or quote some passage from a book
  That tells of no alloy
To dim the brightness of the sun
  That shines on Love's sweet dream.
As we embark and sail along
  The matrimonial stream;

And maids and matrons all remark,
  And give advice most sage
About the way to steer our bark,
  From youth to good old age.
Some tell us how to build a house,
  Some what to put therein;
Some tell us what we need to buy,
  Of china, wood and tin.

All this was told me long ago,
  Some forty years and more,
By loving friends and wishers-well,
  In happy days of yore.
But one, the wisest of them all,
  In accents soft and low,
Said, "Listen, now, and I will tell
  Something you ought to know.

Some people like to keep a dog,
  A little one or big;
And some must have a tony horse
  To draw their handsome rig.
Chickens and turkeys, you should have,
  A cow, with geese and duck,
Is said to bring the money in
  And help along the luck.

All these are good, and do for pets,
  But home is not complete
Unless you have another pair,
  Whose praises I repeat.
Two little Bears should dwell with you—
  I've known their virtues long;
'Bear and Forbear,' if kept in view,
  Will make your life a song."

And so today, as gathered here
  In friendship's happy party,
This good advice I pass along
  With recommend most hearty;
And say to one we all hold dear,
  As on in life she fares,
May every joy your pathway crown,
  But don't forget the Bears.

Every Sunday a beauty contest is held and decided aboard the steamboat City of South Haven on its trip from Chicago to South Haven. The judges in each contest are the captain and two male passengers selected by the contestants themselves and the prizes are annual and trip passes over the company's lines. The contests occasion a great deal of fun and are heartily entered into.

I. C. S. MADE MEN

Later-day business history records the remarkable achievements of many self-made men, but nothing more wonderful than the progress of the vast multitude of students of the International Correspondence Schools, of Scranton, Pa. Thousands of ambitious men and women, aided by the I. C. S. system of training by mail, have been able to advance in place and salary. Many have been able to change their occupation, taking positions in their chosen profession.

The I. C. S. system of training by mail teaches mechanics the theory of their trades; helps misplaced people to qualify for more congenial work; and enables young people to commence work at better salaries than if they started without training.

We can train you, in your spare time, for a position as **Civil, Mechanical, or Electrical Engineer; Architect; Surveyor; Bookkeeper; Stenographer; Ad Writer,** or qualify you for **Civil Service Examinations.** We also teach French, German, and Spanish by the I. C. S. phonograph method.

Write, stating which subject interests you.

International Correspondence Schools
Box 872, Scranton, Pa.

I CURE

Fistula, Piles, Chronic Constipation, Itching Piles, Rectal Fissure, Rectal Ulcers, Stomach, Liver

And All Other Rectal and Intestinal Diseases Without Pain or the Knife.

I make no charge for consultation and examination.

Office hours from 9 a. m. to 6 p. m. Sundays from 9 a. m. to 12 m.

J. M. Auld, M. D.
Chicago's celebrated Expert in Rectal and Intestinal Diseases, who treats patients personally.

If possible call on me for consultation. If not, *Write today for my*

FREE BOOK

"Rectal and Intestinal Diseases—Their Cause and Cure."

J. M. AULD, M. D.

Suite D, 80 Dearborn St., Chicago, Ill.

THREE OUT OF FIVE

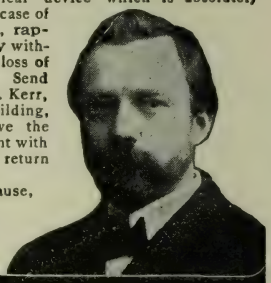
Men suffering from weakened nerve force, constant depression, gloomy forebodings, fast becoming unfitted for active business life, fail to attribute their deplorable state to the proper cause. They know they

HAVE VARICOCELE

as they have suffered much discomfort on account of it, particularly while standing. But the evil effects due to Varicocele are so gradual that they neglect it until the entire system is undermined and they are forced to realize that something must be done to prevent them from breaking down completely. To such sufferer I say, don't fall into the hands of Quacks—don't submit to the knife—don't pay enormous sums to so-called specialists—

Cure Yourself at Home

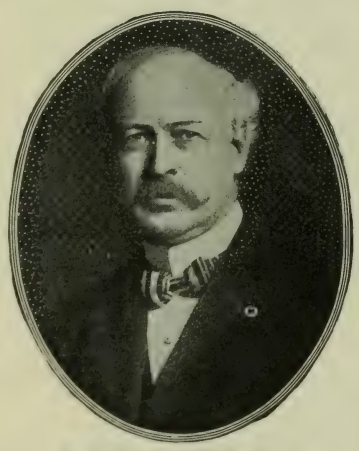
I have successfully treated and cured thousands of cases with a patent mechanical device which is absolutely guaranteed to cure any case of Varicocele painlessly, rapidly and permanently without inconvenience or loss of time from business. Send only **$2.00** to Mark M. Kerr, M. D., 703 Park Building, Cincinnati, and receive the full guaranteed treatment with simple instructions by return mail.



A treatise on the cause, effect and cure of Varicocele sent sealed **FREE OF CHARGE.**

VARICOCELE
HYDROCELE

Cured to Stay Cured in 5 Days
No Cutting or Pain. Guaranteed Cure or Money Refunded



H. J. TILLOTSON, M. D.
The Master Specialist of Chicago, who Cures Varicocele, Hydrocele, and treats patients personally
Established 1880.
(COPYRIGHTED)

VARICOCELE Under my treatment this insidious disease rapidly disappears. Pain ceases almost instantly. The stagnant blood is driven from the dilated veins and all soreness and swelling subsides. Every indication of Varicocele vanishes and in its stead comes the pleasure of perfect health. Many ailments are reflex, originating from other diseases. For instance, innumerable blood and nervous diseases result from poisonous taints in the system. Varicocele and Hydrocele, if neglected will undermine physical strength, depress the mental faculties, derange the nervous system, and ultimately produce complicated results. In treating diseases of men I always cure the effect as well as the cause. I desire that every person afflicted with these or allied diseases write me so I can explain my method of cure, which is safe and permanent. My consultation will cost you nothing, and my charges for a perfect cure will be reasonable and not more than you will be willing to pay for the benefits conferred.

Certainty of Cure is what you want. I give a legal guaranty to cure or refund your money. What I have done for others I can do for you. I can cure you at home.

Correspondence Confidential. One personal visit at my office is preferred, but if it is impossible for you to call, write me your condition fully, and you will receive in plain envelope a scientific and honest opinion of your case, Free of charge. MY HOME TREATMENT IS SUCCESSFUL. My books and lectures mailed free upon application.

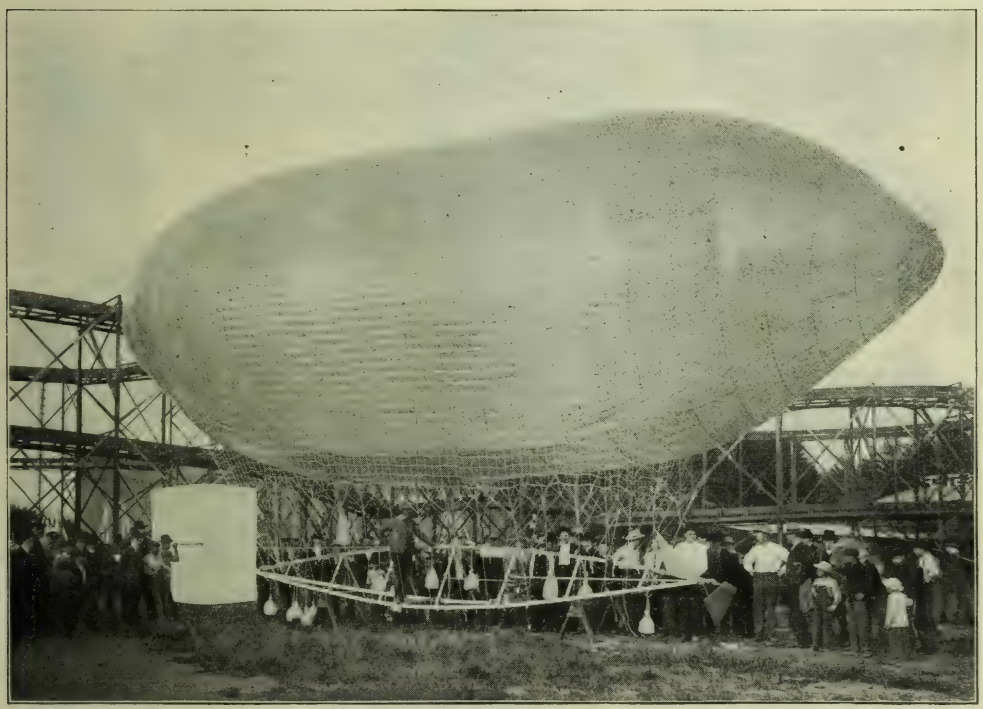
H. J. TILLOTSON, M. D., 271 Tillotson Bldg., 84 Dearborn St., CHICAGO

POPULAR MECHANICS

Vol. 6. No. 10. CHICAGO, OCTOBER, 1904. 10 Cents a copy. $1.00 a year.

Californian's New Airship Successful

Airship building is receiving a great deal of attention from California inventors and some have made notable achievements in this line. Capt. T. S. Baldwin, of Oakland, has invented a new airship with which he has made several successful trips. The first trial was made at Idora Park in Oakland and since then the ascensions have drawn vast crowds of spectators.



A Successful New Airship to be Entered at St. Louis

In these trials no high altitudes were reached, or sought to be attained. The inventor's principal purpose was to determine if the movements of his ship could be controlled. This very important feat he found could be readily accomplished.

At a height of over 600 feet the aeronaut made a number of wide circles going around the large park. He went both against and with the wind; also moving at various angles to the breeze and each time brought his ship back to the starting point, and came down safely. The vessel was found to obey her helm nicely.

These various tests clearly demonstrated that in every revolution of the propeller, and in every move of the steering gear, and

adjustment of the weights which raise or lower the ship at will, the plans of the inventor had been carried out.

Captain Baldwin's airship differs in several important features from other aerial machines. The chief of these is that the large propeller, having two metallic blades and nearly 6 feet in diameter, instead of being placed at the stern, is located at the bow of the frame, or car. In this manner the airship, instead of being driven forward, is pulled through the atmosphere. The inventor claims that this action allows of much greater speed; also that it greatly facilitates the steering, as well as lowering or raising the ship.

The dirigible part, or balloon, is of a blunt, cigar shape, measuring 54 feet long, and 17 feet in diameter in the middle. The balloon is of fine, strong and flexible silk, and with the netting by which it is attached to the car, weighs only 90 pounds. It is inflated with hydrogen gas, and, at ordinary distension, contains 8,000 cubic feet. Some 12 feet below is suspended the frame that supports the propelling and steering mechanism. This frame is constructed of strong light wood in triangular shape, the three ends uniting at a common center at each extreme. The frame is 48 feet long, and is very securely lashed and braced. It has been thoroughly tested, and will support 1,400 pounds with safety.

The engine that drives the propeller is one of the ordinary gasoline type, furnishes seven horsepower, and weighs only 60 pounds. The transmitting mechanism is so adjusted and geared as to drive the propeller at the speed of 150 revolutions per minute. With this power a good speed may be attained under ordinary conditions.

The car weighs 65 pounds. Total weight of the airship is 220 pounds, while its buoyancy will raise nearly 500 pounds.

The rudder, which is rectangular, about 5 by 3½ feet, is worked from any part of the car and the engine is regulated by a steel lever. One person can navigate the airship. The aeronaut can sit about midway of the frame, or he may move about freely without disturbing the general balance. The propeller may be reversed at pleasure, and the vessel pushed backward, if necessary or desirable.

Captain Baldwin intends soon to construct another that will be six feet longer, and weigh 15 pounds less than the present one. This he thinks will add to and facilitate the speed.

WORK OF LOCOMOTIVES DEPENDS ON THEIR FIREMEN.

The large freight locomotives of today are twice as powerful as the engines of a few years ago. This means they must burn twice as much coal to make the twice as much steam required to pull the twice as long trains. In order to get a grate big enough to hold the increased mass of fire the fireboxes have been made longer and wider. This greatly increases the difficulty of firing and requires not only more physical exertion to perform the increased work, but considerably greater skill to do it properly.

At the recent annual convention of railroad master mechanics, who are the men in charge of the repair work on the railways of the country, it was agreed that the modern iron monsters have many disadvantages. The track and bridge engineers have long been in despair over the rapidly growing strains to tracks and bridges imposed by these 120-ton plunging weights, and now the shop men complain the repairs are greater and more frequent and out of proportion to the smaller locomotives.

One expert said: "That the care with which wide fireboxes should be fired is not generally appreciated by the men is, we believe, largely the cause of the numerous troubles due to leaking which are experienced with this type of engine. It is more difficult to maintain an even fire on a large grate than on a small one, and as there is a greater tendency to irregular temperature in the former, it is the direct cause of leakage."

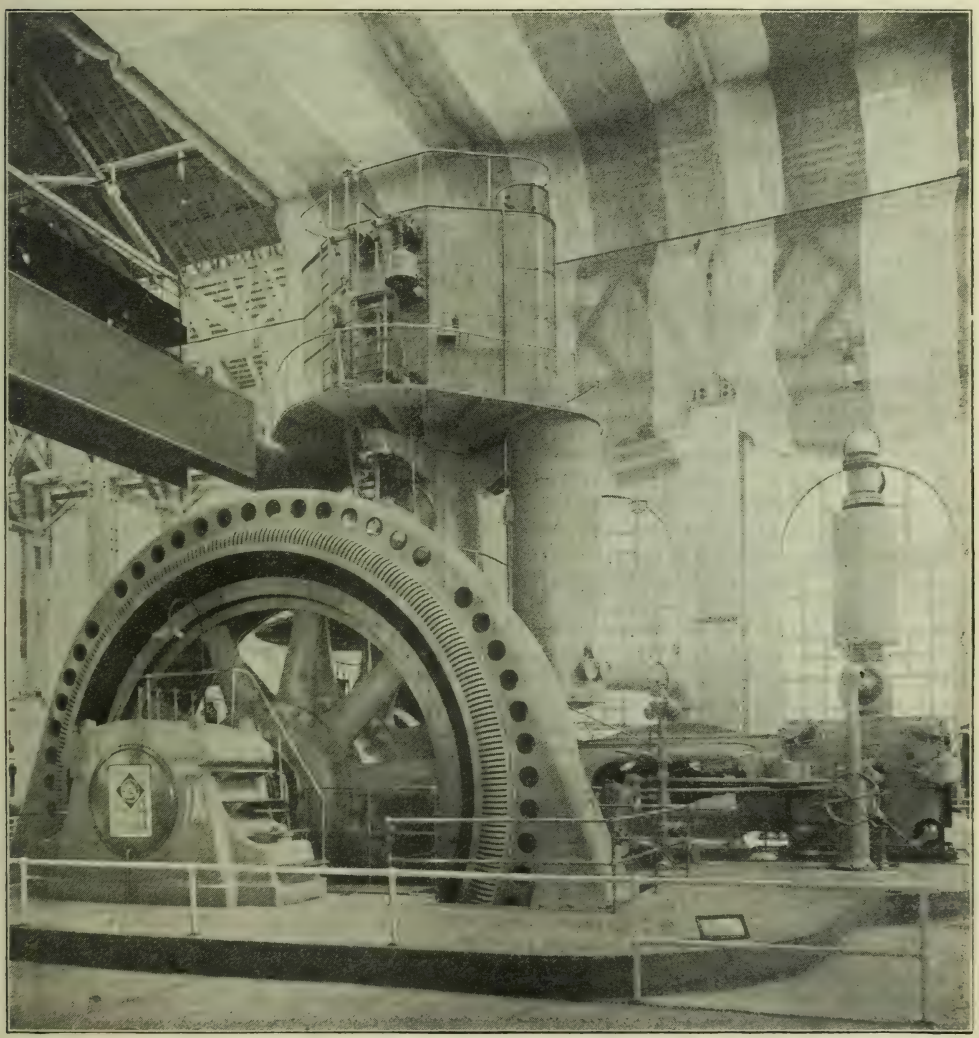
It is also said that the wages paid for this work, while higher than those received by skilled mechanics, who have spent several years in learning a trade, are not sufficiently great in proportion to the severity of the work to attract as competent a class of men as formerly. Muscle is a prime requisite whether there is good judgment along with it or not. In other words, while firing is work which demands brains, it simply cannot be done by a man of inferior strength. Even the strongest cannot do their best work after the first few hours of a trip, owing to fatigue. In some cases this has been remedied by using two firemen who relieve each other every half hour, but this in turn makes long hours for the men.

The solution seems to be in either the use of oil which requires brains and not muscle, or in the use of automatic stokers.

Biggest Engine Ever Exhibited at Any World's Fair.

How Two Hundred Thousand Decorative Incandescent Lamps Are Lighted.

The most notable exhibit in Machinery Hall at the World's Fair is the big 5,000 horsepower engine and electric generator. The engine is of the Manhattan type and is the largest single engine of its kind ever made and by far the largest ever shown at any world's fair. When worked to its full capacity it is capable of producing 8,000 horsepower and aside from being an exhibit, much of the beauty, convenience and success of the Exposition depends upon it. It furnishes the electric current for nearly two hundred thousand 8-candle incandescent lamps during the evenings and for five hours every afternoon furnishes current for a street car line from St. Louis to the Fair



The Big Engine and Generator that Keep 200,000 Incandescent Lamps Aglow.

Grounds and it is often called upon to supply current for many less important functions.

The gradual brightening of the thousands of decorative lights at eventide and the recreation of the wonderful picture of the World's Fair and its features after its fading into the gray of dusk, is one of the most beautiful sights at the Exposition. Dimly, at first, a glow of red, like a remnant of sunset appears along the outlines of the buildings. Slowly it grows brighter until the whole picture seems to be done in fire and then, with stronger current, the lamps grow gradually white in incandescence and the picture is complete.

Visitors standing near the engine may see how this is accomplished. At one corner of the exhibit stands a square cage filled with grid-iron shaped pieces of metal. This is a rheostat and its purpose is to absorb the current created by the exciter for the generator of the engine, and hold it back until it is wanted. On its face is an arm which revolves across a large number of pieces of copper. As this makes a turn it cuts out, bit by bit, the resistance of the rheostat. On top of the cage is a little electric motor which, by means of a chain belt, turns the arm of the rheostat. When the time for lighting arrives an operator at the main switchboard touches a button and the little motor begins to move. As the resistance of the rheostat is gradually cut out the whole number of the decorative lights over the entire Fair begin to glow feebly, but all alike, and then to gain in volume of light, all in accord, as the arm progresses about its circle. One may see the entire operation by standing beside the rheostat at dusk.

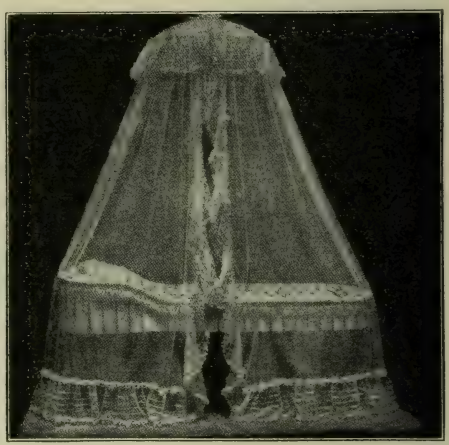
The engine is of the combined vertical and horizontal, compound, condensing type. The high pressure cylinder, which is horizontal, is 44 inches in diameter, and the low pressure cylinder (vertical) is 94 inches in diameter; its steam pressure is 150 pounds. Its shaft is hollow of forged open-hearth steel; is 37 inches in diameter in wheel and generator fits, and weighs 61,000 pounds. The crank weighs 32,000 pounds and the big fly wheel, 25 feet in diameter, weighs 300,000 pounds. The number of revolutions per minute for both engine and generator is 75. The total revolving parts, including the generator, weigh 514,400 pounds, and the whole engine 720 tons. The engine is 39 feet long and stands 39 feet 2 inches above foundation.

The rated capacity of the generator is 3,500 kilowatts. It is of the direct-connected, revolving field type. Its current is 6,600 volts, 25 cycles, 3-phase. The pole pieces number 40. Its collector rings are 51 inches in diameter and the stator yoke 27 feet in diameter, 33 feet over all, and weighs 58,000 pounds.

Words and figures hardly suffice to convey the size and power of this remarkable engine. It is one of the attractions which must not be missed.

A MORTUARY CANOPY.

Funeral directors have accomplished a great deal, and are constantly adopting new methods and mechanical devices which are calculated to make the sad occasion of their visit one of comfort and sympathy, and to avoid everything calculated to intensify the grief-stricken home.



The Canopy.

The automatic mechanism which, without the touch of human hands, gently and noiselessly lowers the casket through a wealth of flowers, is something that has replaced the bungling efforts of inexperienced though well-meaning friends with a substitute at once beautiful and appropriate.

Another feature now in favor is the couch on which the remains are laid while in the home, and the canopy with which it is covered. These are made of imported netting and richly trimmed, the usual colors being white and lavender, all white, gray, black and lavender, all lavender, black and purple, and all black. The canopies are appropriate used for either adults or children's caskets or funeral couches. The illustration shows the manner of its use.

Trent Canal Hydraulic Lift Lock.

Raises 1,300 Tons---Only One of its Kind in America, and the Largest in the World.

View of the Hydraulic Lift Lock from the Lower Reach.

Think of an elevator with the platform 140 feet long and 33 feet wide, lifting 1,300 tons 65 feet vertically; think again of the 1,300 tons including a good sized steamer, its load of freight and passengers and the necessary water to float it, all being lifted together and the entire operation performed in only four minutes, and you have a good idea of one of the latest and most remarkable feats in modern engineering.

The Peterborough hydraulic lift lock, which has just been completed and opened for commerce, is the only lock of this kind in America and one of but four in the world of which it is very much the largest and most interesting as an example of hydraulic engineering.

The Trent canal is not, in the most exact sense, wholly a canal, as almost the whole distance from Lake Huron to the St. Lawrence is through lakes and rivers or on flooded reaches. The length of the route from the Bay of Quinte to Lake Huron is about 200 miles. When completed it is expected that only about 20 miles of this distance will be actual canal. Where canalling is necessary the prism of the canal has a width of 50 feet on the bottom with side slopes in earth of 2 to 1, and in rock ¼ to 1. The slopes in the earth are protected by broken stone placed in a notch cut into the slope.

The standard size of the locks is 134 feet long, 33 feet wide, with 6 feet of water on the sills—though all the lands bought so far for canal purposes have been surveyed and laid out to allow eight feet of water on the sills of the locks. To make all the works so far constructed of the same capacity, would only mean holding the water two feet higher on the sills of the locks by means of extra stop logs placed in the dams, and a slight extra expenditure for the purpose of adapting the present works to the increased depth of water.

The hydraulic lift lock at Peterborough was built to overcome the fall in the waters of the river Otonabee between the two

points, Nassau, about four miles north of the town, and Little Lake, a broadening of the river, opposite the town. The difference in elevation between the two points is 77 feet, the river having that fall in the distance indicated. Above Nassau and up to Lakefield between which points the fall in the river is very pronounced, the river is canalized and made over into several stretches of still water, with locks of the ordinary type between the stretches. Of the difference in level referred to above Nassau and Little Lake, 65 feet is taken care of by the lift lock, the remaining 12 feet being overcome by a lock of the ordinary type placed at the debouchure of the canal into the lake.

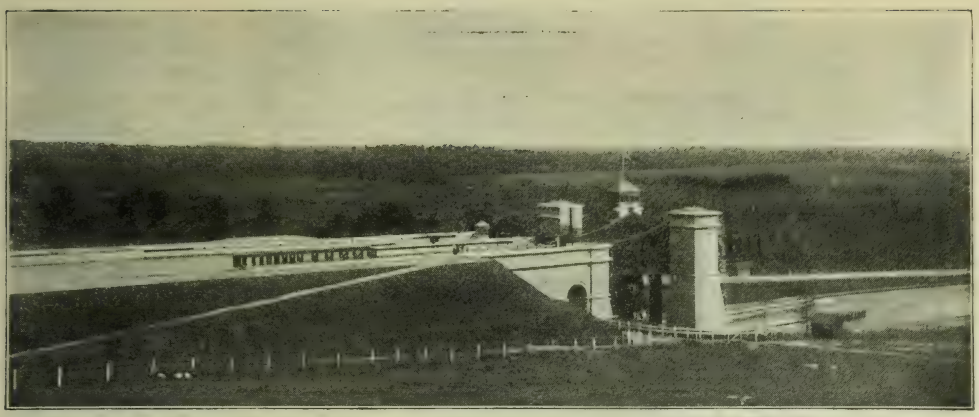
The movement of the lock proper is based on principles long known and well established in the sciences of hydraulics and hydrostatics. Hydraulics relate to the water in motion. Hydrostatics to water at rest. If one takes a cube of iron, say four inches square each way, and drops it into a pail filled to overflowing with water, the piece of iron will sink and displace exactly as much water as will be equivalent to the bulk of the iron. If the iron were hammered or spun, into some form of vessel or dish that would float, then the piece of iron in its new form would displace water exactly equivalent to its weight. So that anything that sinks displaces its bulk of water and anything that floats displaces its weight of water. The application of this principle is seen in the filling of the chambers with water or with boat and water. Fill one chamber with water to the depth of 8 feet, in the other chamber place a barge and water to the same depth, and the load in both chambers will be exactly the same. Hence lockages may be effected with one barge or boat in a chamber, with barges in each chamber, or with the chambers containing water only.

Calculation made of the cubical area of the chamber shows that the load of water is about 1,300 tons (about the equivalent of the weight of 13 of the heaviest locomotives). The duty which the huge ram or piston is called on to perform exceeds this: There is the additional weight of the cantilever or truss construction supporting the chamber, and the ram itself, in all about 1,700 tons.

The special functions of the Peterborough lock are, first, to overcome the elevation; second, the time in which this duty is to be performed, third, the quantity for a given number of lockages or maximum number of tons handled, avoiding a congested traffic. The question for the department of railways and canals to decide was whether the lift should be overcome by locks of the ordinary type, or by such form of lock as that under construction. If of the ordinary type then at least five locks would be required. When these were in use, boats and barges would have to wait until the five lockages had been effected before gaining access. To avoid such delay the locks would have been built in pairs, as is the case at Lockport, on the Erie canal. The cost of these ten locks would have far exceeded the outlay for the hydraulic lock. The time of lockage would have been a serious hindrance to traffic, the attendance a very serious item and the service would have been slower, continually interrupted, and the capacity of the canal at this point restricted. Hydraulic lift locks are planned and built to serve the future as well as the present and to provide for expansion.

The operation of the lock requires three men—a lockmaster, and two assistants or gatemen. The lockmaster will be in charge. The gatemen will be required, one at the lower end and the other at the upper, to open and close the gates, to inflate or deflate the seal tubes between the ends of the chambers and the reaches, and to operate the capstans. It is also necessary for the gatemen to take charge of vessels at a distance of about 200 feet on either side of the lock. The lockmaster, during operations, will be required to stay in his cabin, on the top of the central tower, where he will have full view of all that transpires, and also be in communication with both his assistants by a simple signal system. The lockmaster will have the principal levers before him and through an interlocking system will regulate all the workings of the locks. The levers for controlling gate engines and capstans are situated on the wall immediately above the respective machines, convenient of access to the gateman. The interlocking system is so arranged that the lockmaster must set his levers in the proper order, and these having been set neither he nor his gatemen can err by using their levers at the wrong time.

It is intended that the actual time required in raising the chamber through the whole elevation will be about three minutes. But this will depend upon the adjustment of the main glands, the nicety of the working of the guides and the manipulation of the main valve in the hands of the lockmaster.



General View of the Lock with the Trent River Valley in the Distance

In the European locks this part of the lockage is readily performed in three or four minutes. An ordinary lockage will be conducted in this manner: Suppose 100 tons of "surcharge" has been found to give sufficient additional weight to the descending chamber. The uppermost chamber will then be required to stop with its floor 8¼ inches lower than the bottom of the upper reach. On communication being established between it and the reach, it will receive from the reach 100 tons more than the lower chamber contains, assuming the depth in both reaches to be the same. The total operation to form the lockage, assuming that the gates adjoining the reaches are open and that the seal tubes between the chambers and reaches are inflated, will consist in hauling the vessel into the chamber and mooring her there securely, closing the gates, deflating the seal tubes, and opening the main valve between the presses. The heavier chamber will commence to descend, the motion being allowed to increase gradually by the gradual opening of the valve, until it reaches the maximum speed. At about three quarters of the stroke the main valve is slowly closed, communication between the presses being entirely cut off when the end of the journey is reached. The change in elevation being made the seal tubes are inflated, the gates are opened and the vessel or vessels are free to go on their journey, after being towed out by the capstans. The surcharge contained in the descending chamber simply flows out into the lower reach, while a similar quantity to perform the next lockage is admitted into the chamber which has just reached the higher elevation.

Statistics: Total height, 100 feet; height of lift, 65 feet; breast wall of lock, 40 feet thick, 80 feet high, and 126 feet long; weight of water in each chamber, 1,300 tons; depth of water in chamber, 8 feet; each chamber is 140 feet long, 33 feet wide, 9 feet 10 inches deep, steel; superstructure, concrete 26,000 cubic yards; pressure in operation, 600 pounds per square inch; excavation commenced in 1896; concrete work commenced in 1900; cost, $500,000.

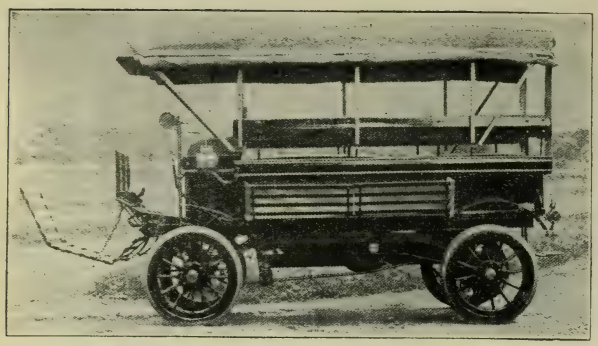
The advantages claimed for the hydraulic lock over those of the ordinary type are saving of time, economy of water and increased capacity. With reference to capacity it will be noticed that vessels traveling in opposite directions may be locked through simultaneously.

A "HOSPITAL TOWN."

At a cost of approximately $8,000,000 Vienna is to have the greatest hospital in the world. It will cover an area of 2,400,000 square feet, and will be in itself a small town having 40 separate buildings in all, 32 of these being clinics and hospitals and 8 offices and residences for the staff.

There will be 18 complete and separate hospitals built on the pavilion or cottage plan and including sick wards, operating and lecture rooms. About 2,300 beds will be provided and each patient will have 1,030 square feet of space. The clinics will all have flat roofs with gardens, for the benefit of consumptives in particular. The operating rooms will be magnificent and of an entirely new type. In clinics for infectious diseases a glass partition will separate the patient from students and professor.

Motor Transfer Service



Colonial Auto Bus

A Pittsburg transfer company now have in use four big colonial 'busses for transferring passengers and baggage. Each of the cars accommodates fifteen passengers comfortably, and has two folding side racks which can be let down for carrying luggage, and a folding rack in front for mail pouches. By leaving off the racks the vehicle can be converted into a patrol wagon.

The machine has a wheel base of 96 inches, 56 inches gage, and weighs, complete, 3,580 pounds. The wheels have solid 4-inch rubber tires.

MILITARY EXPERIMENT COST $500,000.

One of the most interesting and also most expensive military tests ever made recently took place in Germany. It consisted in the erection of a strong, wide bridge over the Elbe by three regiments of military railroad builders in a few days' time. The bridge was built in sections which could be quickly and easily put together and was capable of bearing heavy artillery and army transport. If one section of such a bridge is destroyed by shells or fire another can be quickly substituted. The bridge can be adapted to streams of any width.

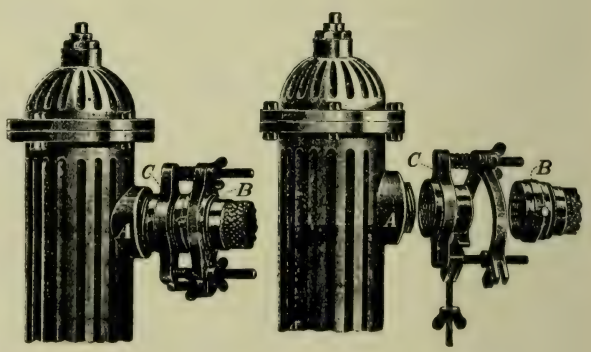
Every precaution was taken to keep outsiders from viewing the bridge or photographing it. The cost of material for the structure and the military experiment amounted to $500,000.

LARGEST TELESCOPE IN THE WORLD.

The largest efficient telescope in the world is to be added to the equipment of Harvard University. The new instrument is 27 feet in focal length and has a 5-foot aperture—nearly twice as large as the Lick observatory telescope, which has a 36-inch aperture. The telescope will be used chiefly for photographic work.

Fire Hose to Fit Any Hydrant

Our readers will remember the prediction made at the time of the Baltimore fire, when fire companies from other cities were unable to connect with the Baltimore hydrants, owing to their hose couplings being of a different size. Such necessities are not long unprovided in these days, and the cut shows a device now available which permits of hose connection to any hydrant, larger or smaller. This makes "connections" of all cities and towns interchangeable, and an absolutely tight joint can be secured in from two to seven seconds. The price of the coupling is $10.



Universal Hose Connection

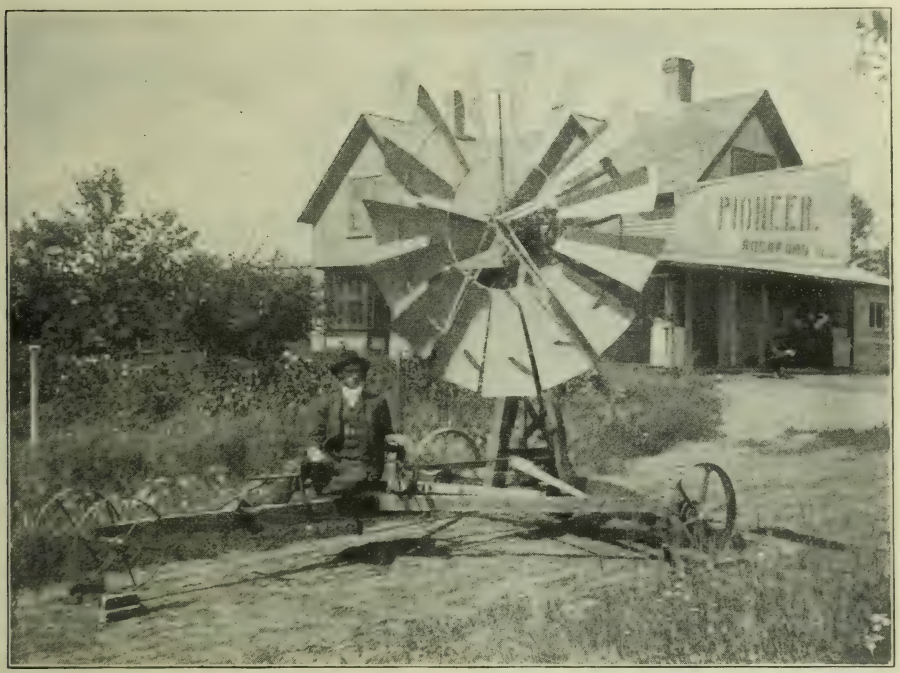
A Windmill Automobile.

Strange Craft that Sails Best Against the Wind--Only Machine of Its Kind in the Country

Somewhat of a novelty in the way of windmills is a traction windmill, contrived by Geo. C. Phillips, of Webster, S. D. There is but one of these machines in this country.

The frame on which the tower is built is a triangle, the center beam is a 2x6, 12 feet long, resting on the guide wheels at the front and on the axle at the rear. Two 2x4's extend from this beam at about half the distance to the outside of the rear. Ten inches in front of the axle is another 2x6 extending crosswise and resting on the beam and side bars thereby forming a triangle that will not rock. Two legs of the tower rest on each beam.

The wheel is an 8-foot steel pumper, remodeled into a geared mill by using some old gear. The windmill is all built of old gear and it was quite a task to find the right sizes and kinds. At first the vane was used, but as this would not hold the wheel in the wind when it was pulling hard, the gear was attached in such a manner that now the wheel can be regulated with the left hand and the speed, also. There are times when both hands are needed and so a screw is used for a steering device and it will stay where it is set.



"The Machine is 12 Feet Long."

This machine runs best against the wind. Of course, it will move sidewise to the wind or with it, but always the best against it. In a good wind it will move about three miles an hour and it could be made to run faster.

The machine is 12 feet long, 9 feet wide and 12 feet high, weighing about 800 pounds. The inventor does not take the machine on the road often as it frightens horses.

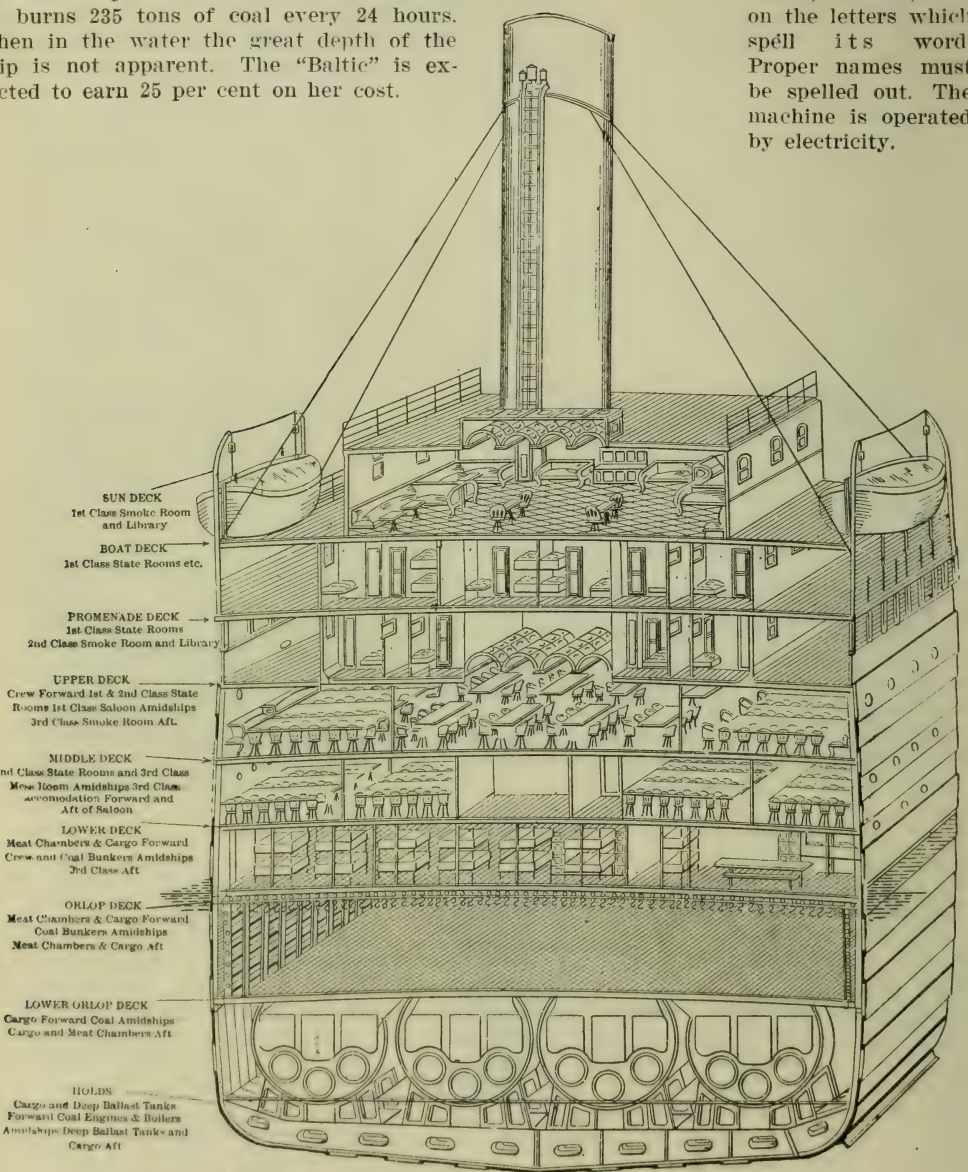
STEAMSHIP EIGHT STORIES HIGH.

A view of how the "Baltic," the largest vessel ever built, would look if cut in two, is given in the illustration which is taken from the American Machinist. The "Baltic" is 735 feet long, 75 feet wide, and is 35 feet longer and has 1,500 tons greater tonnage than the "Great Eastern." Her displacement is 40,000 tons; tonnage, 24,000 tons; can accommodate 3,000 passengers, and carries a crew of 350 persons. When at sea the vessel burns 235 tons of coal every 24 hours. When in the water the great depth of the ship is not apparent. The "Baltic" is expected to earn 25 per cent on her cost.

MECHANICAL STENOGRAPHERS.

It is reported that a Cincinnati inventor has perfected a machine which reproduces in typewritten form the words spoken by a human voice into its receiver, including a vocabulary of 2,500 words and, if needed, can be adapted to the use of other words.

The machine has a small copper disc for each of the 2,500 words and the spoken word acts only on its particular disc, which, in turn, acts on the letters which spell its word. Proper names must be spelled out. The machine is operated by electricity.


SUN DECK
1st Class Smoke Room and Library
BOAT DECK
1st Class State Rooms etc.
PROMENADE DECK
1st Class State Rooms
2nd Class Smoke Room and Library
UPPER DECK
Crew Forward 1st & 2nd Class State Rooms 1st Class Saloon Amidships 3rd Class Smoke Room Aft.
MIDDLE DECK
2nd Class State Rooms and 3rd Class Mess Room Amidships 3rd Class accomodation Forward and Aft of Saloon
LOWER DECK
Meat Chambers & Cargo Forward Crew and Coal Bunkers Amidships 3rd Class Aft
ORLOP DECK
Meat Chambers & Cargo Forward Coal Bunkers Amidships Meat Chambers & Cargo Aft
LOWER ORLOP DECK
Cargo Forward Coal Amidships Cargo and Meat Chambers Aft
HOLDS
Cargo and Deep Ballast Tanks Forward Coal Engines & Boilers Amidships Deep Ballast Tanks and Cargo Aft

Cross Section of Steamship "Baltic"

Mechanical Figures Almost Human.

Talk in Several Languages, Walk, Ride Bicycles, Write and Breathe---Appear to be Alive, and Do Almost Everything but Think.

It was a dingy loft-like place, away back in the rear and at the top of an old building in Chicago. The door was closed and locked and the big sign of "Positively No Admittance" was anything but encouraging. The first attempts at the little push button apparently accomplished nothing but to sound a big bell somewhere. After awhile the door was opened, and a little old man in the most ancient straw hat and puffing vigorously at a cob pipe, stood before me. My errand was quickly stated and after looking me over for fully half a minute, he evidently relented and bade me enter. Fortunately I had happened on one of the days when he was inclined to talk.

I followed along, threading my way in the dim light between ghastly rows of half-formed men and women. A motley assortment of arms and legs were hanging from the walls, and heads in various degrees of construction lay on boxes or tables where they had been carelessly thrown, and interspersed were hands and ears, while a nose was stuck on a nail which protruded from a packing box.

Then came the work benches and here were tools the shape and purpose of which I could not guess. Above the benches, which were covered with all manner of materials, rose long shelves crowded with the most motley collection of brass rods, springs of every imaginable description, screws, wires, bunches of human hair, handfuls of glass eyes, bottles with strange smelling chemicals, magnets, electric motors, storage batteries and hundreds of things the purpose of which no man could imagine.

It was the work shop of a genuine twentieth century mechanical wizard.

"So you want to see the 'figgers,' do you?" said he, as we paused at the end of the room where a little better light was struggling through some very grimy windows.

"Well, I'm pretty busy, so you just talk to this young lady here, and she can tell you all about it," and his eyes seemed to twinkle mischievously, which at that time I attributed to the smoke from his stalwart pipe.

"Nellie, this is one of those editors from that Pop'lar Mechanics, you just tell him all about how we make 'em."

In every feature she was beautiful as she sat leaning back in an arm chair, gowned exquisitely in garments of the latest style and evidently of expensive material. "Must

"Nellie, Exquisitely Gowned, Sat Leaning Back in an Arm Chair"

be the old man's daughter, but what a place for her here," I thought as she rose in a queenly manner and gracefully extended her hand.

"I am very glad to meet you," she said in a rather captivating tone. "Won't you be seated?"

Her large brown eyes looked steadily at me through a bit of lace veil that certainly was very fetching, but the unexpected meeting, and an indescribable sense of horror at taking her hand which was decidedly

clammy, combined to upset me somewhat, so I stammered out, "Yes, I guess so, thank you," but remained standing.

"Yes?" she remarked with a rising inflection.

"I came up to get acquainted with the figures, and learn something of their construction," I remarked.

"It's a very pleasant day," she replied, with a suggestion of changing the subject.

"And I am anxious to find out the mechanical features of their construction—"

"Are you fond of golf?" she interrupted.

"And what motive power is employed, springs or electricity, or —"

A bust of merry laughter, a coquettish toss of the head and a gesture which apparently dismissed the subject was my response. Then she swept majestically past me and stepping over to the window stopped and appeared to be looking out.

"Well, how are you coming on?" said the old man who had returned.

The young lady at this juncture turned and remarked—

"I believe I would like to ride my wheel."

"Crazy," I muttered, "and no wonder in such a crazy place as this."

Her father cleared a space on the floor and bringing out a bicycle assisted her to mount, which she did in a rather amateurish manner, I thought.

"All ready," he said, and thereupon the fair one began to circle the room, riding steadily and smoothly, but with increasing speed, until I trembled for her safety. Time and again she barely missed striking some obstruction, but each time flew past unharmed. In about two minutes he reached out and brought the wheel to a standstill and assisted her to a chair. She appeared to be considerably out of breath from the violent exercise, and the gold locket on her bosom was rising and falling vigorously.

"She took me two years, and cost $3,000," said he slapping me on the back, "but she's worth it."

It was beginning to dawn upon me that this cheerful beauty with the highly informal manner was a mechanical creation of this strange genius. And so she was.

Those work shops were a revelation. It seems impossible that a few inanimate materials could be made to assume so many of the human attitudes with such startling similarity to life. There were women in street, travelling and ballroom costumes, which, when touched by the wizard's hand cleverly imitated the manners of well-bred society, handling their fans with perfect ease and assuming the most natural attitudes.

There were others who spoke in almost any language one might suggest. One woman chattered away as she perked her head first to one side and then the other, carefully applying a face cream to a complexion that was already without blemish, and actually breathed as regularly as though she were human. She will soon be seen in a store window and wondering crowds will block the sidewalks in front. In a comfortable chair in one corner of the room a man sat at ease and his gaze followed us as we moved about. He, too, was a talking figure.

The figures have meant years of toil, a watchfulness of details almost too painstaking for even the twentieth century, and not only a great deal of mechanical ingenuity, but a thorough knowledge of anatomy, also. The result is most startling. The foundation of the figures is entirely of papier maché, making them durable and light, but the exposed parts of the body, arms, hands, shoulders and head are beautifully covered with wax, delicately and naturally tinted, as with the pink flush of good red blood. Natural eye brows, lashes and beautifully arranged hair add their part and then the figure is dressed with care and taste.

For the talking figures small phonographs are placed within the chest and of course, records in any language, for any conversation, song, speech, laughter or sound desired can be placed and replaced when wished. The talking mechanism is the least marvelous feature of all.

The details of construction and methods of joining the parts of the body, and especially the application of equilibrium are carefully guarded secrets of the maker. Even if a skilled mechanic had a walking figure as a model it would be extremely difficult for him to make one just like it do the same movements. These secrets are the result of years of study and experiment. Some of the smallest details cost weeks of unbroken work, while others were the result of scores of fruitless trials covering a period of years. This much I learned: The arms and legs are drawn up by specially constructed rubber cords which are set in action by the movement of a lever released by a magnet, all concealed within the limb. The extension or straightening out of the arm or leg is accomplished by wires moved by strong magnets connected to a light but

powerful battery placed in the trunk of the body. In the walking figures the equilibrium is maintained by a tube of mercury which passes from the front to the back at the base of the trunk near its center. All the motions of the eyes, head and limbs are electrically operated or controlled from delicate apparatus in the head. A comprehensive, detailed explanation of just how all this is done would require many pages and be understood only by an expert electrician.

One of these figures, now on exhibition on the stage, deports itself in such a natural manner that many an audience believed it was being made sport of by a human being. To overcome this impression the figure is disjointed before the people; its wig removed and a small electric light inside the head turned on to show that the figure is run by springs and batteries instead of gray matter. This figure walks out on the stage and makes a speech; is then mounted on a bicycle having curved handle bars, its feet placed on the pedals and without further assistance or support rides around on the stage. When removed from the wheel it walks to a blackboard and writes its name, "Elmer Miller," in a hand sufficiently legible to be read by the audience.

The idea of these figures is being used for other purposes than displays in shop windows. Very life-like pigs which squeal, grunt and root around is one of these and a big packer has ordered several thousand of them for advertising purposes.

The work of perfectly imitating both human and animal life is certainly an ambitious one, and has been favored with a remarkable degree of success.

A Mechanical Figure Which "Speaks Six Languages Fluently"

KILLING WEEDS ON SHIPS' BOTTOMS WITH ELECTRICITY.

The growth of weeds on the bottoms of ships and also the oxidation of the plates may some day be prevented by electrolysis. The plan is feasible in nearly every particular save cost, and this may in time be decreased.

The ship's plating is made the negative pole and insulated copper pieces the positive pole of an electrolytic cell through which the current, generated by the ship's dynamo or a battery, is passed. Hydrogen, liberated from the sea water, prevents oxidation of the plates, whilst the resultant caustic soda kills all barnacles and weeds.

The working cost, however, must be considered. For a 300-foot ship, having 15,000 square feet of wetted surface, three amperes would be required to keep pace with the scouring effect of the ship's passage through the water. To be effective the work must go on all the time, both day and night at a cost of about $5 an hour or $120 per day, a considerable sum to add to a ship's working expense. It would also be necessary to carry a 225-kilowatt dynamo outfit.

THE GREAT AIRSHIP RACE.

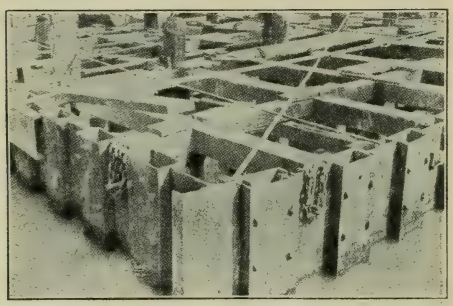
Considering the wide publicity of the affair, the outcome of the airship race from the Fair Grounds to the Washington Monument falls nothing short of ridiculous.

For the wonderful aerial craft were substituted two balloons, such as feature every circus that strikes our villages. The first balloon, after remaining in the air two hours and a half, came down in a cornfield, and was shipped back to St. Louis. The other wandered at will until in the vicinity of Wyoming, Ill., and then came down.

COFFERDAMS OF I-BEAMS.

The New System of Interlocking Steel Sheeting

A new system of building cofferdams, making deep water excavations or other deep excavations is being demonstrated in Chicago, and engineers everywhere are asking themselves why someone did not do the work this way years ago. Like many another great thing, its simplicity is its most remarkable feature. The new system consists in bolting two channel irons together, forming a hollow iron tube, which is connected to the next tube by an I-beam of



Cofferdam--Chicago River

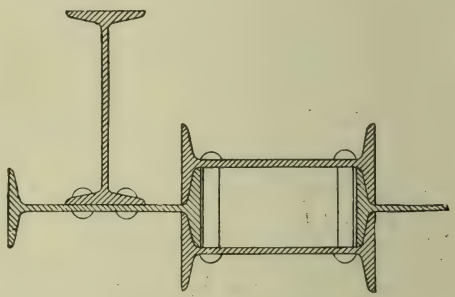
standard size. The tubes and I-beams are driven by a pile driver, the same as piles.

For this work nothing special is required. The I-beams are standard, 18 inches wide, and weigh 55 pounds to the foot; the channels are 15-inch channels, weighing 33 pounds per foot.

The illustration shows the manner of connecting the sheeting, which may be extended to any desired distance. At the corners an L is formed by riveting two I-beams together. There is no limit, within reason, of the height to which the steel sheeting is made. In practice here in Chicago as little as four feet in earth has answered to hold the sheeting for 19 feet above; probably six feet has been the average here. Where the excavation is deep or the work of retaining heavy, inside bracing of timber must be used. The sheeting has been spliced and driven here to a length of 40 feet.

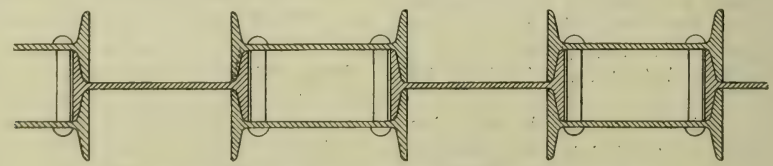
One highly desirable feature of the method is the comparative ease with which the sheeting can be pulled when its purpose is served. It can then be used again indefinitely. The channels, beams and balls are all standard, and can be bought in any large city out of stock. For work in water the sheeting is made practically water-tight by filling the columns with clay.

Already in Chicago the new method has been used with great success in a cofferdam in the Chicago river, where the water is 20 feet deep and the excavation within the dam was 31 feet deep; also in tunnel work on the lake front, and to retain the foundations and earth beneath, under one



Plan of Corner

of the large pumps in the Chicago avenue city pumping station. At this place we made a careful examination and in spite of the constant operation of the immense pump, which is of the walking beam type, there appeared no settling or cracks after three

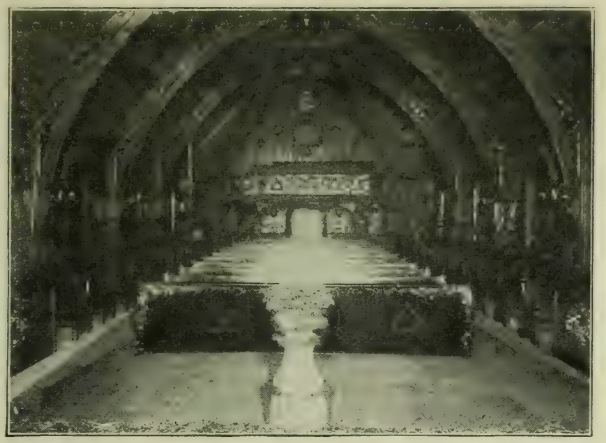


Plan View of Connecting Sheeting

retaining wall can be carried. The wall is made by driving to a suitable depth; the bottom end is not sharpened, but will go through almost anything except, of course, stone. The nature of the soil has much to do with the length which must be left completely in the ground after the excavation weeks' operation. The sheeting was driven within a few feet of the pump and an excavation 40 feet square made to a depth of 20 feet. The new system, which is patented, can be rented for periods of 90 days or more and effects a great saving over the use of wooden piling.

Floating Church a Boon to Seamen.

At the foot of Pike street, New York, not far from where all the great lines of the Atlantic land their mighty volume of traffic, floats an unusual little craft which year in and year out never leaves its moorings and yet is most popular among thousands of sailors. It is in fact a floating church built upon a scow 85 feet long and 45 feet wide. The structure was completed in 1879 at a cost of $25,000 and since that time many are the seamen who have had reason to bless it. It is supported by the Protestant Episcopal Church Missionary Society, of which notorious Bishop Potter is president, and which also maintains a reading room and gymnasium for the sailors. Services are held regularly in the little church and a steam launch 70 feet long with a carrying capacity of 50 persons brings the sailors from the vessels in the harbor to the church and returns them again. This mission boat "Sentinel" also visits its incoming and outgoing vessels and those in port as well and ministers to the needs of the seamen.

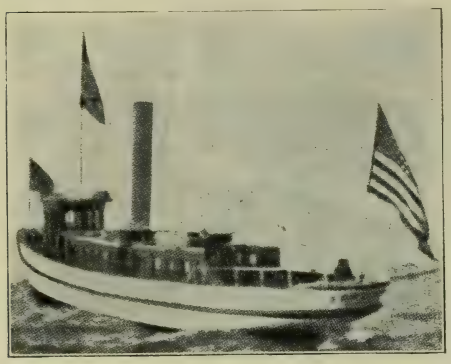


Interior of the Floating Church.

The gymnasium and reading room are to the sailor like a bit of the homelife he often longs for, but

Floating Church for Seamen, New York.

can rarely enjoy. Last year 441 religious services were held in the floating church with a total attendance of 20,099 seamen.



Mission Boat "Sentinel"

The good work of the society is especially apparent in the number of letters the sailors write to and receive from their families and friends and in the increased amount of money deposited for safe keeping. A Free Shipping Bureau obtains employment for sailors, and a Legal Aid Society investigates all complaints.

GEARLESS AUTOMOBILE IN FRANCE.

A firm of French builders have produced an electric automobile which is gearless. The armature of the motor has for its shaft the axle of the vehicle carrying the driving wheels. At a recent test the machine ran on speeds ranging from 4½ to 19 miles an hour. The machine is noiseless. Gearless motors were tried in the United States on street cars some years ago but were not an entire success and few if any are now in use.

MANUFACTURES POLES

So far as good straight poles are concerned, it will matter little hereafter if our forests deteriorate and the trees grow crookedly. A big factory, equipped with the finest machinery of its kind, for manufacturing poles which are stronger than they were in the natural state, has just been established at Little Rock, Ark.

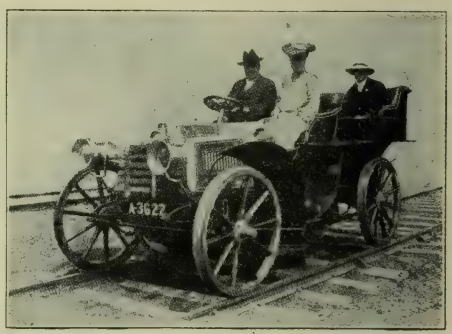
The lathes take a 30-foot stick and if it is crooked it is straightened on the tenon and socket plan. Each joint is straightened by an iron band imbedded in the wood around it. The poles can be built to heights of 50 or 60 feet if desired and are shipped in sections. They are built from any length of timber, yellow pine being used, but are not jointed under 30 feet. The base is made separately in the form of a sleeve into which the pole slips. The base is creosoted to preserve the wood and the entire pole is chemically treated and painted either red or green. In the United States 33,000 poles are used per day.

AUTOMOBILES THAT RUN ON RAILROAD TRACKS.

The railroad companies are not likely to look with special favor on the new steel-flanged wheels which are a recent English invention, and which enable an automobile fitted with them to travel safely and with great speed on a steam railroad track.

Charles J. Glidden, who is attempting to encircle the globe in his auto, has received a set from London, and with permission already obtained from the Canadian Pacific, will use that track across the continent, starting from Minneapolis. The auto will follow a passenger train at a respectful distance, and will be in charge of one of the company's conductors as long as it is on the road, which it will be for 2,000 miles. Train orders will issue the same as for any extra train, and it will run as a second section of a regular passenger train.

The Automobile says: "This is the first

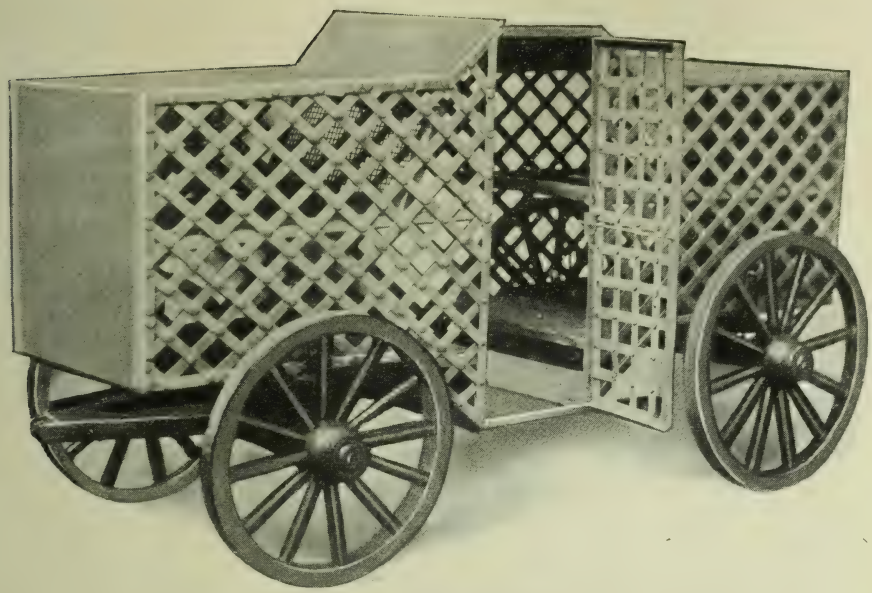


"No Steering Necessary"

occasion on which a regular road touring car has been fitted with flanged wheels for railway travel. The wheels are stoutly made of ash and closely resemble the ordinary automobile wheels, except for the rims. Each wheel weighs 250 pounds."

Mr. Glidden has sent several barrels of gasoline ahead to insure a supply at places where autos are unknown, and expects to average 30 miles an hour while running. No steering will be necessary, as the wheels will follow the rail.

Portable Jails in Which Convicts are Caged at Night



A Portable Steel Convict Cage

In many of the southern states convicts who work on the public roads by day, often some distance from the jail, are now caged for safe-keeping at night, instead of being returned several miles to the jail or placed under an expensive and uncertain guard.

Portable steel cages are used for this purpose. Each cage is 14 feet long, 3 feet 6 inches wide and high enough at the entrance for the prisoner to stand erect, while the ends which are equipped with four bunks each, are not so high. The floor, ceilings and ends of the cages are made of heavy steel, while the sides are of 3/16x2-inch steel bars, set obliquely at right angles to each other and riveted together by ⅜-inch rivets. The cages are easily drawn by two horses.

RAILWAY RUN OF 245¾ MILES MADE DAILY WITHOUT STOP.

The longest non-stopping railway run is made twice daily in England between Paddington, a suburb of London, to Plymouth, Truro, Falmouth and Penzance down in the Devonshire and Cornwall district. To realize how great this distance to be made by established daily runs without stop one has but to take a map of England and trace the course of the Great Western road over which the run is made.

The morning express leaves Paddington at 10:10. The average speed of the express is 55.6 miles an hour and this speed is maintained despite the fact that there are grades of 1 in 43 and 1 in 48; that through Bath and the five Dawlish tunnels the speed must slacken to 15 miles, to 10 miles around Bristol and 5 miles through Exeter. The greater portion of the distance is comparatively easy, however, and in places a speed of from 65 to 69 miles an hour is maintained. The route passes through London, Reading, Bath, Bristol, Exeter and Plymouth, where the first stop is made; then on to Truro, Falmouth and Penzance. The corresponding return run is also made daily.

No other road in the world has an established daily non-stopping run so long as this, though there are occasionally special runs made which are longer.

Adirondack Forest Fires Largely the Work of Incendiaries

The report of the U. S. Bureau of Forestry for 1903 states that the forest fires in the Adirondacks which destroyed about 600,000 acres of timber and were fought at an expense of $175,000, were in many instances started by patriotic New Yorkers from various motives, usually personal greed. Probably 75,000 acres were fire-swept by reason of fires deliberately started. In some instances they were started by men who found that fighting fires at $2.00 per day was more profitable than their usual employment; small boys who found pleasure in the excitement kindled others; hunters started fires in localities where they wished the green grass to attract the deer in the spring; berry pickers had found the fires favorable to the growth of berry bushes; ginseng gatherers' work was made easier thereby, and there was an instance where a fire was started without any apparent motive and where, had the wind veered, the incendiary would have suffered a loss. One-half of the fires due to carelessness were caught from locomotives. Spark arresters, such as were recently described in Popular Mechanics, would have prevented much of the loss.

Of all the game which suffered, perhaps the trout fared the worst, several bushels of the dead fish being washed up in one place. Two boys waded into Boquet river and captured 92 brown trout which were hardly able to move.

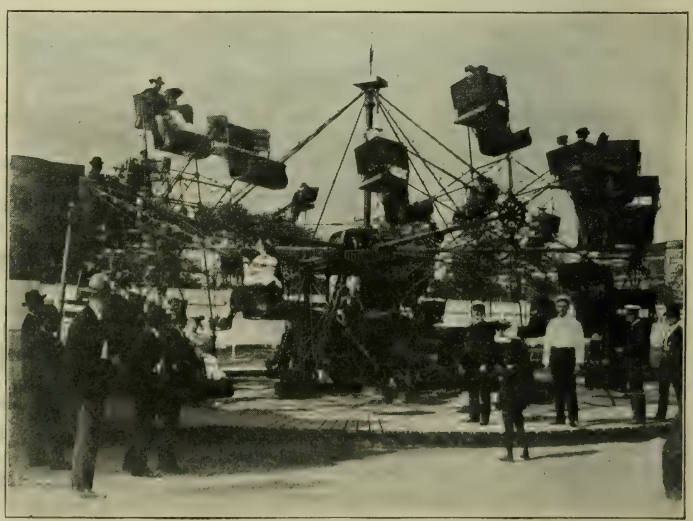
Usually the points to be protected were divided into districts, each under a deputy warden in charge of the men who fought the fires. The method of fighting surface fires was to clear a wide path of lifter. If water could be obtained this path was wet down and shovelfuls of sand were thrown on burning wood. Young spruce or balsam were used to thrash out burning grass in the clearing. From the path so made the men fought the fire. Usually the presence of duff made trenches 1 to 4 feet wide necessary, sometimes such trenches completely encircled the fire.

Back firing was necessary in cases where the fires were too hot for men to fight. Trenches were dug and along the side of the approaching fire another fire was started, burning away from the trench and meeting the coming fire at a distance great enough to rob its fury of some of the danger.

There have been some prosecutions of incendiaries, one man was sent to the state penitentiary; he had started 24 fires.

ELECTRIC DOUBLE WHIRL.

The electric double whirl is a new feature for parks and pleasure resorts. It is operated by a 35-horsepower electric motor and combines the forward motion of a merry-go-round with the rolling action of a Ferris wheel. There are six of the wheels each having six seats carrying two passengers. The sensation of the double motion, which is an unusual one, is said to be quite pleasing and the first machine now in operation in Chicago has become very popular. At night it is brightly illuminated with hundreds of electric lights which form a kaleidoscope of brilliant colors and forms.



The "Double Whirl," a Delightful Amusement Device

Traction Engine Travels in the Air

Engineer Refuses to Leave His Post and Rides With His Machine

Suspended by a little ⅝-inch wire rope, so high in the air that it seemed a comparatively small object, a huge traction engine, weighing six tons, crossed the Miami river at Dayton, O., by cable to the second pier of the new Third street bridge now under course of construction. The engine was needed at the spot to pump the water from the cofferdam and the cable solved the problem for the bridge contractors, Hoglen & Kline.

Transporting a 6-Ton Traction Engine by Cable

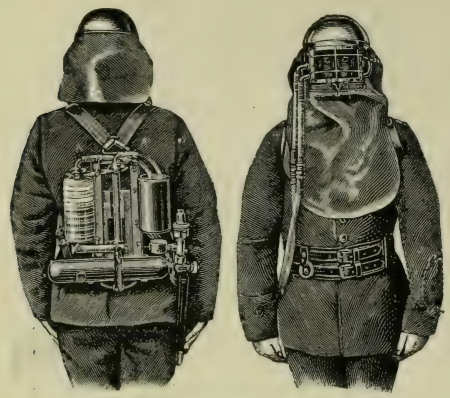
Two tall towers support the cables on which hang travelers used to transport all material to any spot where it is required. Back of each of the two towers is a double connected drum controlling the two wire ropes which hang under the cable. The top rope pulls the traveler block back and forth; the lower rope raises and lowers the hoisting block which hangs under the traveler block. A tackle was fastened to the engine and it was raised and transported on the little rope, which, however, has carried eight tons safely. The engineer, who ran the drum had the receiver of a telephone strapped to his ears enabling him to receive directions from the other end of the wire as to the progress of his strange load. The engineer of the traction refused to leave his post even during the trip, and so he made the passage high in air, standing on the footboard of his engine. Steam was on, and he was able to signal frequently to the men below, by means of the whistle on the engine. It was one of the most unusual trips ever made by a traction engine, but was accomplished in safety.

LIPTON AGAIN IN THE RACE.

Sir Thomas Lipton has announced that it may be he is stubborn, but he cannot admit that he is beaten and will again challenge for the America's cup. Last year, after the third successive defeat in the international yacht race, Sir Thomas declared that it was his last attempt. This year he will build a new yacht, the Shamrock IV, for the occasion and declares that while his designers believe the new rules will add to his chances of success, he himself would prefer to race under the old and more stringent conditions. This would indeed make a more gratifying victory, but it is to be feared that Sir Thomas will never achieve it.

SAFETY DEVICE FOR MINERS.

A recent French invention for use in mines subject to deadly gases, enables an inspector to walk fearlessly into chambers filled with fumes one breath of which mean



Life Saving Device

instant death. The apparatus which is carried on the back, is set in action by pressing a button and immediately begins to produce sufficient oxygen to supply the requirements. Rubber tubes conduct the gas to a rubber bag carried on the breast and which is a part of a tight-fitting helmet much like that worn by a diver. The device is also suitable for firemen working in dense smoke or rooms filled with the fumes of deadly chemicals.

POLITENESS PAYS.

It frequently happens that clerks, and some others also, in answering a business call over the telephone, fail to reply with the same politeness which they would had

When Using This Telephone

REMEMBER that a stranger is at the other end of the line.

REMEMBER that the tone of your voice may make him a customer or drive him away.

MAKE a customer of him and you increase your usefulness to this office.

THEREFORE, when using this telephone always be polite, agreeable, accommodating and patient.

ACT, when you answer a call, as though it were the only bit of work you are called upon to do all day, and do it in an absolutely perfect manner.

the customer called in person. The accompanying suggestion has been printed and distributed to its patrons by a telephone company in a western city.

GEORGE WASHINGTON'S FIRE ENGINE.

Up until the time George Washington left to take command of the Continental army he was a member of Friendship Engine Co., of Alexandria, Va., which was organized in 1774. When he left he presented the company with a fire engine which was still in use many years after Washington's death, says the Firemen's Herald.

George had a reputation for prompt and efficient action, as we all know. In the last year of his life, 1799, there was a fire and this same engine was poorly manned, while many idlers stood by, unwilling to soil their clothing. Gen'l Washington was there, too, and dismounting, rebuked the loafers,

"Washington Seized the Brake"

and seizing the brake, helped work the engine. There was no lack of help after that. The illustration is taken from an old print made at the time of the incident.

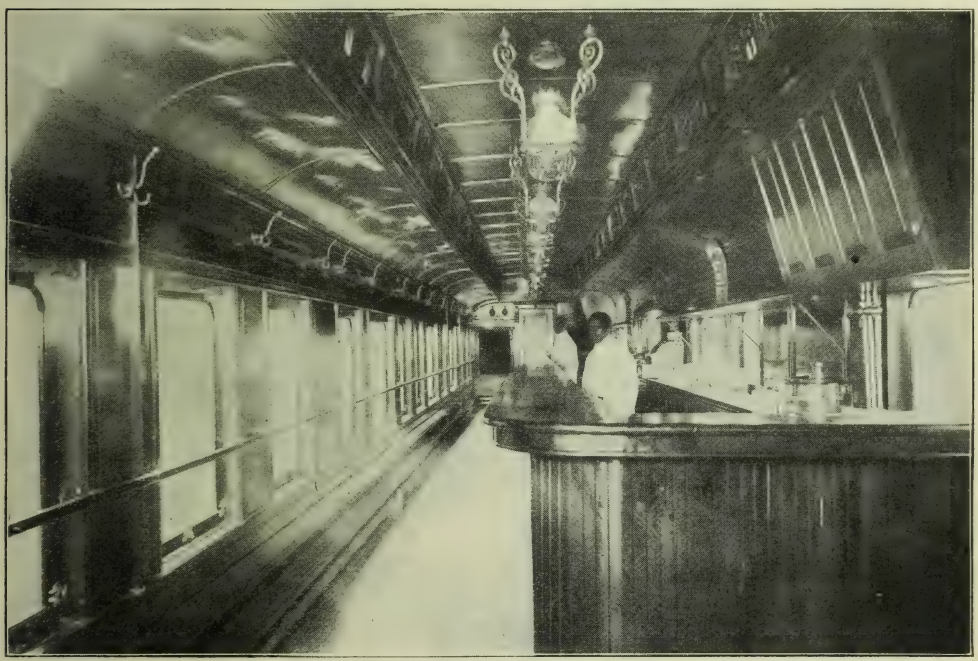
MOST ENORMOUS SCALES EVER USED—WEIGHED THE SUN'S CORONA.

Would you believe that 25,000,000 tons or 50,000,000,000 pounds could be a light weight for anything? Well, it is, or at least so declares the great Swedish astronomer, Professor August Svante Arrhenius, who has recently weighed the sun's corona, or the luminous field surrounding the sun, and who declares himself surprised that the weight is no greater. Professor Arrhenius made the atmosphere, the temperature and the telescope his scales and a mind long trained for solving solar problems did the rest.

Professor Arrhenius has settled several other light problems which had long puzzled astronomers.

Lunch Counter Car a Great Hit

Passengers on the Pere Marquette trains between Chicago and Michigan resorts have enjoyed a novel and happy feature of railway service the past summer. At the end of the week many business men rush from their offices just in time to catch the noon train and having no time for lunch before leaving the city. To meet the requirements of these hungry patrons would have necessitated the running of several dining cars to each train had not Mr. H. F. Moeller, general passenger agent at Detroit, evolved the brilliant idea of fitting up a lunch car which would accommodate a goodly number quickly, easily and at popular prices.



A Lunch Counter Car

An old parlor car was used for the purpose and a counter 3 feet 9 inches high, 16 inches wide and 42½ feet long with extensions at the ends running to the side wall was built in it. This counter is of pine, stained and finished to match the car, and has a walnut top. At each end of the counter 6 feet of space is left and 3½ feet at the side. Behind the counter along the wall were built lockers, cupboards and shelving with steam heated tea and coffee urns located centrally and overhead water-tanks at each end of the shelving. Under the counter are sinks with hot and cold water. Sixty people can stand at the counter, while the car will hold from 150 to 200 persons. There are no stools and no one is allowed to loiter. The platforms of the car are protected by railings and it can only be entered from other cars.

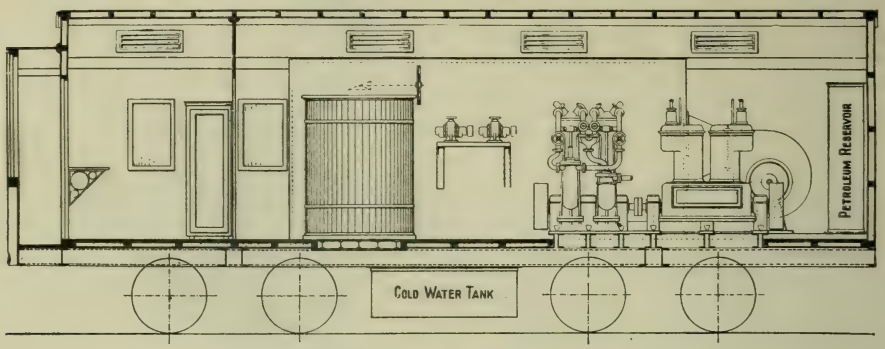
Anything common to other lunch counters may be had on the car; doughnuts, pie, sandwiches, ice cream, lemonade, milk, coffee, etc., and each article is listed at 10 cents.

To obtain the same heating value from wood and coal it takes two and one-half times as much wood in weight for each square foot of grate surface as it does of coal. In other words, the heating value of one pound of coal is equal to that of two and one-half pounds of pine wood.

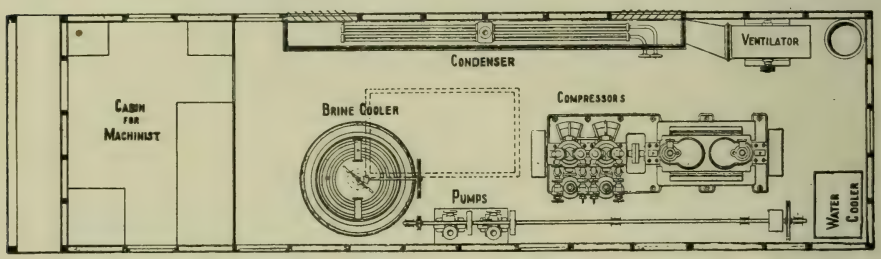
A trolley dining car is a new institution on the Aurora, Elgin and Chicago third-rail interurban line.

COLD STORAGE PLANT ON RAILS.

A portable cold storage plant is in operation on the Trans-Siberian railroad. From the first impression of ice and cold that usually attaches to the very word "Siberia," anything to produce artificial cold would seem superfluous. Nor was the new method a war necessity, but rather a plain business proposition to transport butter, eggs, poultry and other perishables over the thousands of miles which separate the termini of this road.



Side Elevation Refrigerating Car



Plan of Refrigerating Car

The system is comparatively simple. The cooling plant occupies one car from which the cold brine is pumped through connecting pipes to the cars immediately ahead and behind. The plant, which is operated by a gas engine, is not unlike plants for similar purposes employed in cold storage warehouses. The machinery is kept in constant operation during the trip, maintaining a temperature in all the cars supplied with the service at from 35½ to 39 degrees F. The ventilator is run only when the train stops and is for the purpose of cooling the condenser. A sleeping compartment is partitioned off at one end of the car where the two men in charge sleep. Ice and Refrigeration says: "As the cars used for carrying the butter were on the ordinary freight car pattern, with doors on the sides, the brine pipe was necessarily placed beneath the roofs. The cars are insulated with double boards and paper between, in connection with mineral wool. The doors are not opened from the time of loading until the end of the trip."

GOVERNMENT TRIES NEW SYSTEM OF WIRELESS TELEGRAPHY.

The first of a series of experiments with the American system of wireless telegraphy was made on the United States cruiser "Topeka" a few days ago, when it carried the delegates to the American Institute of Electrical Engineers up the Hudson river. The instruments for the system were invented by Professor Fessenden, of Washington, and naval officers believe the system is superior to that now in use on American war ships. The "Topeka" was equipped with instruments and wireless stations were established at the navy yard and Navesink Highlands, N. J. The "Topeka" has been specially detailed to conduct these tests and will make a long-distance test of the apparatus soon.

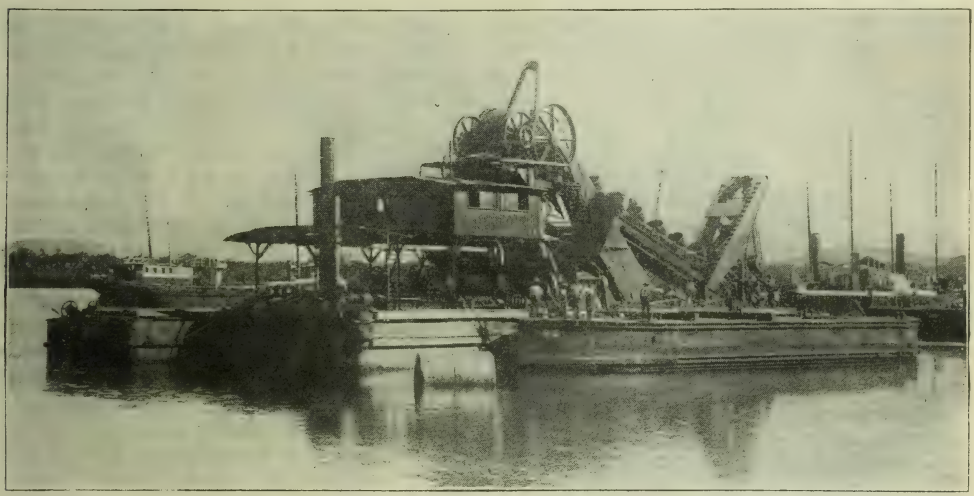
Preparatory Work on the Panama Canal

The Boneyard of France to be Reclaimed -- Will Renew Life of American Commerce and Industries -- Expect to Make Health Resort of a Death Bog

The great engineering feats of a nation are the athletics by which she renews and develops her strength. On such a course of training, which will probably cover a decade, the United States has just entered, the seat of action being the little isthmus of Panama.

The first step was the summarizing of the conditions, chiefly climatic, to be dealt with, and for this purpose William Bartley Parsons, one of our greatest engineers, made a thorough inspection of the canal zone. John Findley Wallace is to have the active superintendence of construction. The second step, and this too is now under way, comprises the specifications and plans for the construction of the big canal, beginning with the smallest appliance required and ending with the completed channel which at the spot where it severs two continents will also unite two mighty oceans and will divert the accustomed courses of the fleets of every nation.

The canal zone in its present state is little more than a graveyard of French ambitions. Millions of dollars of the wealth of that nation are buried there and the graves of many of her most promising manhood tell better than words can how great was the price of her failure. Altogether, France expended $20,000,000 in machinery and appliances for digging the canal. There are 2,431 buildings on the isthmus but these would not house all the machinery sent there at the time. Many of these buildings were hospitals and executive quarters and will be used again by American engineers and officials, but of the machinery, that which can be used will not exceed in value $2,000,000; the rest is a total loss to France. This is due partly to the fact that the machinery is now out-of-date, but aside from that, France purchased lavishly—extravagantly—machinery which was already out-of-date and which was not sufficiently powerful to perform the work. But the greatest cause of the deterioration has been the climate. Iron and steel, unless the most careful precautions are taken, are no more proof against the hot, humid atmosphere of the isthmus than if they were the frailest of substances. With the famous Culebra cut, France abandoned miles on miles of steel rails piled to a height of six feet; numerous rows of Belgian locomotives, too small for their purpose; acres of land set apart only as yards for hundreds of car wheels, huge buckets, scoops, engines, dredges and



Old Dredges at the Pacific Terminus of the Panama Canal

appliances of every nature and description all subject to a common fate and few which will ever serve their original purpose. Many of these heavy articles are buried from five to seventeen feet in the soft silty soil in which they had sunk deeper every day. If unearthed, one might cut their outer surfaces into small pieces like bits of rubber or cork. Some of the costly houses on the isthmus are built on foundations of $60,000 worth of machinery! Stable foundations for buildings are hard to get and what more natural than that the machinery strewn everywhere should be put to the only purpose it could serve? The moisture coats every bit of exposed metal deep with rust. Wherever a bit of earth is overturned or an excavation is made a white mist rises from the soil—a mist which bred disease and dealt death in the camps of the French and also wrought ruin to their costly equipment.

A striking exception to this general ruin is one of the big machine shops found hidden away in the brush near Bas Matachin. When the place was cleared sufficiently to allow an investigation it was found that the shop was complete and well equipped. It consisted of a machine shop, boiler shop, blacksmith shop, locomotive erecting shop, planing mill, car repair shop and foundry. The machinery and material in this instance, after having been stored away for more than 20 years, were still in average good condition and in the latter part of July the shop was in working order and the wheels began to roll.

Machinery and material well housed in good shops are, of course, better protected from the elements than are huge derricks, piles of rails, scoops, dredges, locomotives, etc., for which no proper storage could be provided because of the lack of lumber. Twenty years in the open air during all kinds of weather in any climate would have its effect on most machinery. The lack of lumber, the engineers declare, is their greatest handicap in the canal district. Everything else is plentiful, but lumber is hard to get at any price.

The methods of the United States will in nowise resemble those of France. The most startling change projected will be the transforming of this wild, enervating death bog into a habitable country which for several months of the year will be a popular health resort. Two great sanitary innovations

Present Appearance of the Famous Culebra Cut

Excavating Machinery and Old Railways on the Route of the Canal

will accomplish this result, it is believed. Such an elaborate and carefully planned system of sewers will be laid as no city of our New World can boast, and also miles on miles of iron piping for carrying an abundant water supply. On these matters more than on anything else depends the success of the Panama canal. Add to this an active war for the extermination of the mosquito which will be waged at any cost. It is now established that the human body is infected with yellow fever only through mosquito bites and this fact alone makes the mosquito war important. The governor-general of the canal zone has called on the canal commission for 100,000 yards of galvanized steel wire gauze, not coarser than 17 meshes to the square inch, to be used as a protection against the mosquitoes. The De Lesseps houses at Cristobal will require 2,000 yards, 20,000 yards will be used to enclose hospitals and 75,000 yards for houses along the canal zone. Some of the swamps, which are breeding places of the insects, will be drained, others will be treated with chemicals and in still other localiites the water level will be raised by the Bohio dam. Numerous new electrical devices will also be experimented with.

The most pronounced marks of modern methods will be found in the fact that wherever feasible and practicable electrical machinery will be used. Compressed air and steam will be employed to an extent but the electrical devices will far outnumber these. Fully a year's time will be required for selecting and designing the machinery to be used. This work will be so complete that the whole force on the canal can work independent of the rest of the world for a number of years. Numerous repair shops will be established, equipped in every particular. Duplicate parts of much of the machinery will be provided and in many instances where the wear and strain are great the entire machine will be sent in duplicate. Plants where the engineering corps can forge parts will also be installed, so that no delay can possibly occur in the work which at best will cover a number of years. The whole outfit will be figured out accurately before it is shipped. Fuel will be one of the prime factors in determining the nature of the machinery in every case. Wood is out of the question as an exclusive power-producing fuel; coal is too high-priced in Panama and water-power is to no great degree available. Liquid fuel, it is estimated, will

be the cheapest and best, it being possible to deliver Texas oil at the isthmus at about a dollar a barrel.

The old French dredges and steam shovels will be used for secondary work, the new dredges and shovels will be twice as large as the old ones. Cable ways extending from steel towers will stretch across the canal at frequent intervals. These cables will be wonderful affairs irrespective of anything else. The motor that operates the hoist will convey 90 cubic feet of excavated material at the rate of 1,000 feet per minute.

Roughly estimated, there are 45,000,000 cubic yards of material to be excavated. Steam dredges and shovels by dozens, and steam and electric derricks and cranes will be employed. Solid rock will be cut through by means of compressed air and electric drills, and electric batteries will set off dynamite cartridges for exploding rock. Special processes for rendering all the metal

Old Abandoned Derricks on the Panama Canal

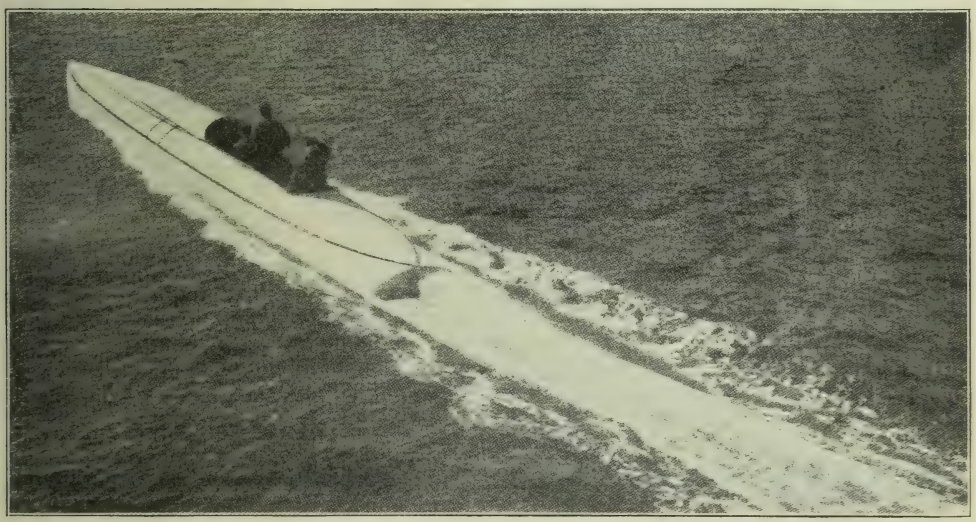
be located on a platform on one of the towers, and ofttimes the man who operates the dump will be a quarter of a mile away from the excavating place. The hoist can be operated to fulfill any need. It can be elevated to any height desired and run to any part of the line wished. The whole corps will be kept in touch by means of electric signals and telephonic connections between the entire system of cables will be established. The skip on most of the cables will

parts of this vast amount of machinery rust-proof and moisture-proof will be employed. In such a climate the electrical machinery has proven more serviceable than steam and it is believed that electrical markets all over the country will receive a great stimulus.

The time it will require to finish the canal is estimated at from six to twelve years, but these estimates are uncertain. John Findley Wallace says it depends not on the amount of material to be excavated, but on

the amount of work men can do in that climate. Negroes will be the chief laborers, and fully 20,000 will be required whereas there are now about 1,000 available. The laborers will be clad in the fewest garments consistent with decency and even then many of them will die of heat and exhaustion. So far as cost is concerned the country is assuming a burden which will not, for a generation at least, be self-sustaining though many indirect profits will accrue. Most of the estimates place the total cost at approximately $200,000,000, but no one counts the cost and no one thinks of failure. In the next few years this great project may bring financial wreck to many; Panama may be the last resting place of some of the brightest and bravest of our land and many anxious eyes will be turned thither for long days and nights, but all these are for the country's good. Panama will be a school where many valuable lessons will be learned and undoubtedly many valuable inventions be given to the world. The canal will be an advertisement for American machinery and South America, that Eldorado of the manufacturer, will be affected. The saving in the route from New York to Australia and eastern Asia will be so great that whereas the European countries now have the advantage over us, we will then have the advantage. But greater than all these financial benefits, it is conceded, is the sentimental aspect of the case. The two shores of our broad land will be united by a direct waterway, and in times of war the advantage is obvious. In fact, it was the dashing trip made by the "Oregon" during the war with Spain which made the need of a shorter water route so apparent. These, rather than any pecuniary considerations, are the mighty issues and near interests that have inspired the American people to take up with glad hearts the burden of the Panama canal.

Motor Boats Race Across English Channel



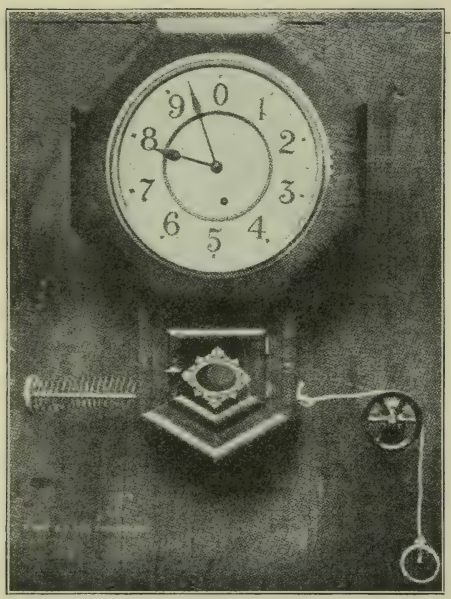
The "Mercedes IV" Under Full Headway

Motor boat racing is quite the fad now on the other side, and is already dividing honors with the automobile contests. On August 8 there was a spirited race across the English Channel, which was won by the "Mercedes IV." This boat made the trip from Calais to Dover, a distance of 22 nautical miles, in one hour, seven and two-fifths seconds, a record never beaten but once, and that was by the 9,000-horsepower turbine steamer "Queen." The "Mercedes IV." has a 90-horsepower Mercedes motor and the machinery was protected from splashing water. She carried a crew of three.

A TEN-HOUR CLOCK.

Labor-Saving Device for Computing Time

This 10-hour clock saves time and labor in computing the time of the employes in a Philadelphia factory. It was made from an ordinary time-keeper, the only difference being the new dial, which was painted on white paper and pasted over the one already there, and the year ratio between the



Ten-Hour Clock

hour and minute hands changed from 12 to 10. The clock then read in hours and tenths of hours. When work starts in the morning (in this shop it is 7 o'clock) both hands point straight up at "0." When the whistle blows the clock is started by pulling on the rope, shown in the cut. At noon, when the whistle blows, the clock is stopped with the hands pointing at 5 o'clock.

The special function is the ease with which the time spent on any job can be figured. Railway and Locomotive Engineering says:

"Under the time-keeping system employed the men are instructed to enter on their time cards the number past which the short hand stands, and to the right of this, the number past which the long hand stands. These numbers, side by side, are entered on a time card when a job is begun, and immediately above them two other numbers are placed when the job is finished. For example, a job is begun at 8:15 a. m. The time entered as shown by the ten hour clock is 1, 2, and if the job be completed at 3:45 p. m. the time as shown by the clock is 8, 0. The difference between these is 6, 8 or 6 hours and eight-tenths, or 6.8 hours. This time paid for at 27½ cents per hour, gives the simple operation in multiplication 6.8×.275=$1.87.

"The clock can be used as it stands for any length of hours or length of shifts. It is possible to arrange the starting and stopping mechanism of the clock so that the act of blowing whistle will start and stop the clock. The use of this device simplifies the time-keeper's work and eliminates much of the liability to error which exists with methods usually employed."

HOW MEXICANS PROSPECT FOR WATER.

In the semi-arid regions of northern Mexico and the southwestern part of the United States the hunt for water is carried on with great perseverence and varying success, says Modern Mexico. The "vaqueros" and "pastores" (cowboys and shepherds) of Sonora, Chihuahua and Coahuila have certain tests which they claim are even more certain than the witch hazel switch of the water witch. The following are some of them: Where it is suspected that water may be found in a well of reasonable depth, extend a sheep's pelt with the wool up. In the middle place a fresh egg. Cover by an earthen jar glazed inside when the earth is perfectly dry and the day warm, clear and without wind. At sunrise, on the next day, lift the jar, and if the egg and the wool near it are covered with dew, water will be found at a slight depth. If the egg is dry and the wool damp, water will be found at a greater depth, but if there is no dew either on the egg or the wool there is no water to be found in that vicinity. Another receipt is: Grind 60 grains of quicklime and mix it with an equal quantity of paris green and sulphur. Put the mixture in a new jar with twenty grams of unwashed wool. The mouth of the jar should be sealed with an earthenware stopper of the same material as the jar itself. Then weigh it, and when the atmosphere is perfectly dry bury it about eight inches below the surface of the ground and cover it up, beating down the earth. Dig up the jar 24 hours afterwards and weigh it. If the weight has increased in the meantime water may be found by digging, but if it weighs less there is no water in the vicinity.

Where Warring Nations Meet on Neutral Ground

Where Russian and Japanese Officers Meet Daily and Salute.

Not far from Newchwang and yet located on the neutral ground of Northern China is a station where Russian and Japanese officers meet daily and salute each other with cold, contemptuous civility. The place, known as Shan-hai-kwan, is one of the railway stations where every nation keeps a force large enough to guard its interests and this atmosphere of internationalism is enough to hold the bitterest foes subdued. Chinese military police, creatures who resemble withered hags, keep order in the place. In the illustration the Chinese wall is shown in the distance on the mountain. In Shan-hai-kwan the Japanese and Russian railway officials try to outdo each other in the thoroughness with which they do their work, look after baggage, travelers, etc. The situation is most unique, for doubtless a murderous hate lurks in the hearts of natives of the opposed nations as they meet day after day.

CHICAGO'S WATER WASTE IS 4,000,000,000 GALLONS ANNUALLY.

Recent investigation has revealed the fact that Chicago loses $390,000 annually in water waste! This means that a great percent of the "pumped" water slips back into Lake Michigan and never reaches the water mains of Chicago.

Engineers declare that all pumping stations lose about three per cent of the total amount which is assumed to be pumped, but by the figures recently given out Chicago is burning tons upon tons of coal uselessly and her citizens are not enjoying the water supply they should have.

To leaking pistons in the pumping engines is ascribed this annual 4,000,000,000-gallon loss of water. In one station the proportion lost was 10 per cent; at this ratio in all the stations it would amount to 13,000,000,000 gallons yearly, but it is not believed to be so great at other stations.

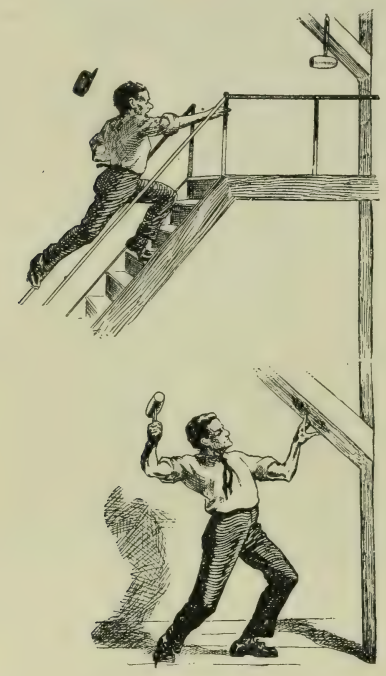
The pitometers used to detect the amount of waste are rarely accurate, city engineers say, and any figures gained in this way cannot be depended upon.

POUNDING THE SOLID CHOKE.

How the New Boy in the Flour Mill is Initiated

Every trade has its time-honored jokes which, year after year, are played upon the ever new crop of beginners. This one is a flour mill story contributed to the American Miller:

Being behind on orders we ran 15 hours, then 18. Orders continued to come until we were compelled to run day and night.



"Pound Her, Bill."

This caused the writer to begin his day at noon and end it at midnight, when his second would relieve him.

The best help is generally given the second, while the head miller must get along with any old thing. Following this rule the sweeper, who for the present I will call Bill, was assigned to me as oiler and sweeper. Now Bill—, but I will not try to describe him beyond saying that he was a wild and woolly sort of fellow; a big duffer, but harmless.

One night about 10 o'clock I was going over the mill examining the stock as usual. This time Bill went with me. It seemed strange to him that I must look into almost every spout. We were in the basement. Bill thought I was looking for a choke-up and wanted to assist me by telling me where it was.

"Never mind, Bill, I'll find it," said I, "and when I do it will be a bad one."

Going up to the next floor I shouted: "Come, Bill! Come on, quick!"

Well, Bill did not see the stair steps at all. He grabbed the mallet, on the run.

"Here it is," I said; "pound this spout till I tell you to quit. It's choked solid."

I went up to the next floor and stopped. Well, I laughed until I almost went straight up. I went back to see how Bill was getting along. "Pound her, Bill. She's solid," I said.

I stepped into the dark, where the rest of the boys were standing watching Bill pound the 4x4 brace till he wore out one mallet. He sailed up to the next floor after another mallet and pounded the 4x4 until I went to him and said: "All right, Bill, she's O. K. Come now, let us go down to the boiler room and talk about the choke."

Laugh? Well, I guess yes. I laughed more that night than ever since. Bill did not know till the next day that the spout was really solid. There is a bruised spot on that 4x4 yet.

NO PLUSH CAR SEATS IN KENTUCKY.

It has remained for the Kentucky state board of health to take the first step against the use of plush car seats which collect and hold disease germs until the next passenger comes along to receive them into his system. The board will indict every railway official in the state whom it can reach who is responsible for the use of seats upholstered with heavy plush.

Leather or cane for both sleepers and day coaches are the substitutes the board will permit, and of the two, cane is preferable, for the leather seats are hot and uncomfortable. Linen makes a good seat covering, as it can be removed and laundered frequently. The effects of this initiative move may extend to other states until all our railway systems will have sanitary car seats.

An important step toward uniting the ice-bound country of Alaska with the outer world has lately been completed: the new government cable connecting that territory with American lines having been spliced by the cable ship "Burnside" in Puget Sound.

High Bridge at St. Paul Wrecked

"It Reaches a Height of 200 Feet."

The terrific cyclone which swept down the Mississippi valley a few weeks ago and did more than a million dollars' damage in the Twin Cities numbered among its playthings the huge structure known throughout the Northwest as the High Bridge. This bridge which spans the Mississippi at St. Paul is famous for the same thing that high bridges throughout the world are noted for—a jumping-off place.

The bridge which has a total length of 2,770 feet starts from the west bank of the river at an elevation of 90 feet above low water and ascends with a grade of 4 per cent until on the opposite shore it reaches a height of 200 feet. It has a 24-foot roadway and two 8-foot sidewalks and was built in 1889 at a cost of $479,878. The cyclone carried away two 60-foot plate girder spans, one 170-foot span, a trestle tower carrying a 50-foot span, and one 250-foot span. Iron was twisted in all shapes and 2-inch bolts were broken. Altogether 500 tons of iron fell, 267 tons lodging in the river.

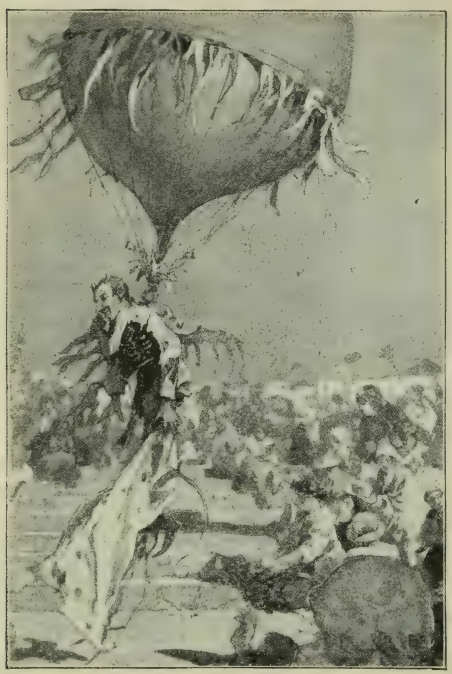
The wreckage is being cleared away and the bridge will be reconstructed. L. W. Rundlett, Commissioner of Public Works, St. Paul, kindly furnished us with the photograph of the bridge and the facts.

CITY WATER WORKS RUN BY ALCOHOL MOTOR.

At Matanzas, a Cuban city of 40,000 inhabitants, the city water works are run by an alcohol motor pump of German manufacture, reports U. S. Minister Squiers at Habana, Cuba. The installation cost $6,000, and the 45-horsepower motor pump is operated at a fuel cost of $4 per 10-hour day and pumps 1,000,000 gallons of water.

OUTWITTING SATAN

Many of us might have reason to be thankful could we rid ourselves of the attentions of His Satanic Majesty so easily as do the peasants of Val di Rose. These superstitious people are troubled by the arch-fiend but once a year, and that occasion is always followed by great merry-making and rejoicing.



Rid of the Devil for Another Year.

Every year on the first day of August all the people of Val di Rose gather in a great square, which is the public threshing floor, also. The ludicrous ceremony which then occurs is presided over by the most intellectual man in the community. With a solemnity, such as graces all acts of mighty import, this man attaches a very realistic puppet representing the devil to a small fire balloon, which he then liberates. And all the people rejoice, for they believe that their dreams will be peaceful and their vintage uninjured for another year.

RAIN-PROOF HATS.

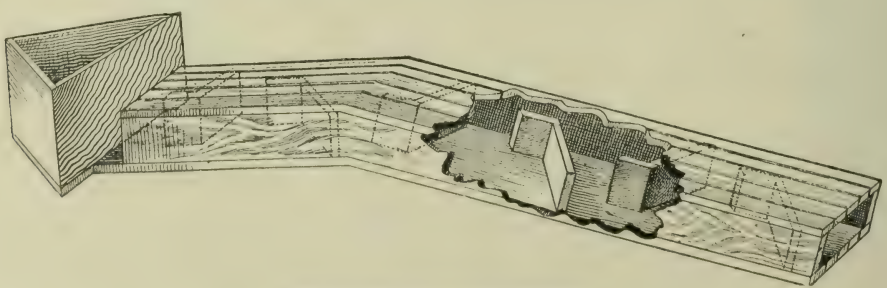
Rrain-proof hats, which can be worn in the heaviest downpour and yet retain all their delicate tintings, exquisite style and original shapes unimpaired, is the latest Parisian fad. The hats are made of celluloid especially prepared for the purpose so that it can be woven into imitations of the finest straw. It is also modeled into flowers for trimming the hats. The hats are beautiful, for the celluloid is susceptible to the most delicate tints. So long as the hats are a fad they will meet with feminine favor, but after that they will spoil the necessities for new bonnets too often to suit most women.

FISH LADDERS FOR MINNESOTA DAMS.

The Fish Commissioners of Minnesota have ordered fish ladders placed on every dam in the state. These ladders must be three feet in length for each foot of height.

The crib or bulkhead is constructed of oak, using 6x6 material and the corners being mitred and bolted. It is filled with rock for anchorage. The top of the crib stands out of the water about a foot higher than the main chute, which extends from the crib to the water below the dam.

The chute is constructed of 2-inch material. It extends to within two feet of the bottom of the river and into the pool below the dam. It is placed in the channel of the stream, and when the greatest depth of water is found the chute is supported from the bottom of the stream by "horses" or similar supports.



Fish Ladder Adopted in Minnesota.

England Suffers From the Cotton Famine

England's greatest industry is the cotton industry and in certain localities whole towns are given up to the huge mills where every man, woman and child earns its daily bread, often whole families being employed. The world's cotton output has not kept pace with its population and now there is a shortage of cotton and the poor people of Lancashire are working short hours, barely earning enough to sustain life. The short time, however, was necessary to keep the price of cotton from rising and thus bringing on a greater evil, financial panic. The crisis is said to be the severest since the cotton famine during the Civil War in this country.

Typical Scene in English Cotton Mill.

England hopes, by furthering in every way possible, the cultivation of cotton in her African colonies to be able to meet such conditions in the future. How much the welfare of her people depend upon it is apparent at a glance into one of her busy cotton mills, teeming with life and labor. The winding frames with their innumerable spindles and bobbins of fleecy cotton and the never ceasing whirr of the winding is especially interesting. The faces of the employes form an unpleasing contrast to those found in our own busy factories. Where our laborers are bright with interest and many tokens of active intellect, these have dull, heavy countenances which seem as though they could look no farther than each day's grinding round in the cotton mill.

AMERICANS DRINK 910,000,000 GLASSES OF SODA WATER.

The soda water season is closing. A simple statement, but few know all that it means, or how great a commercial feature the soda water season is. In the United States alone, says the Soda Fountain, 75,000 merchants sell soda water, averaging sales of $730 a year, or a total of $54,750,000 per annum. The average price of drinks is six cents, giving the number of drinks as 910,000,000. Could the glasses required to serve this many drinks be placed side by side they would reach to within a day's travel of once around the world. These figures do not include pop, ginger ale, root beer, etc., but only sales made at the fountain.

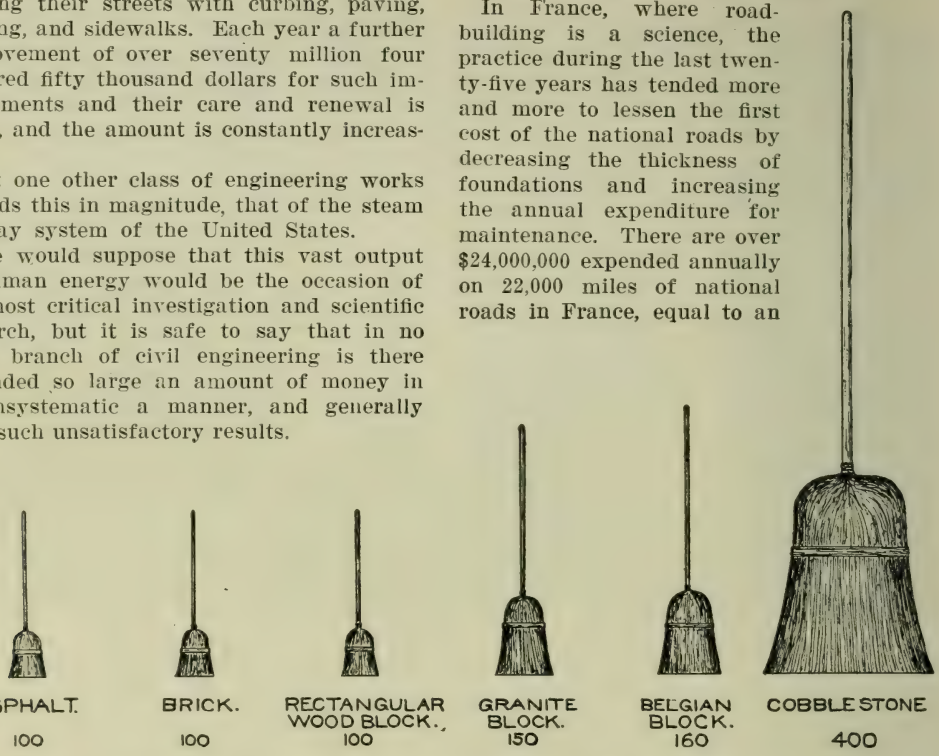
The Street Paving Problem

[Extracted from the Report of John W. Alvord, Chicago.]

At the beginning of the 20th century 24,000,000 of the population of the United States living in cities of 8,000 and over had invested approximately $850,000,000 in improving their streets with curbing, paving, grading, and sidewalks. Each year a further improvement of over seventy million four hundred fifty thousand dollars for such improvements and their care and renewal is made, and the amount is constantly increasing.

But one other class of engineering works exceeds this in magnitude, that of the steam railway system of the United States.

One would suppose that this vast output of human energy would be the occasion of the most critical investigation and scientific research, but it is safe to say that in no other branch of civil engineering is there expended so large an amount of money in so unsystematic a manner, and generally with such unsatisfactory results.



Showing Relative Amounts of Labor Necessary to Clean Various Pavements

Pavements are primarily designed to accommodate travel, but scarcely any one in this country thinks of investigating the travel of a city systematically and thoroughly before proceeding to lay down pavements.

Pavements have been a necessity of civilization since Rome was mistress of the world, but cities are still experimenting with the subject without general and well-defined policies. Community after community repeats the fundamental experiments, and copies without reflection or study what they see being done elsewhere.

The railways of the country know to a penny the cost in life service and the comparative utility of every bolt and scrap of iron that enters into their composition. They can tell you to several places of decimals the cost of moving a ton-mile of freight and the transportation of a passenger.

In France, where road-building is a science, the practice during the last twenty-five years has tended more and more to lessen the first cost of the national roads by decreasing the thickness of foundations and increasing the annual expenditure for maintenance. There are over $24,000,000 expended annually on 22,000 miles of national roads in France, equal to an average of $225.00 per mile per annum for repairs alone on country roads.

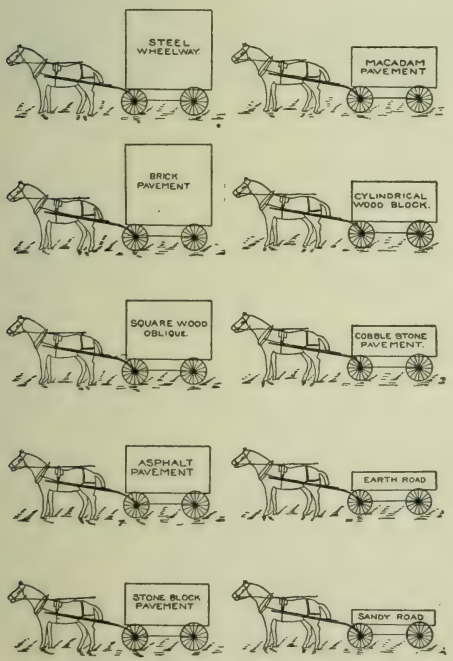
A report from 135 American cities from 1890 to 1901 show that of new pavements the following percentages were laid:

Asphalt	33 per cent
Brick	25 per cent
Macadam	23 per cent
Granite	8 per cent
Wood	7 per cent
Miscellaneous	4 per cent

Residence streets should not be paved wider than 18 feet, which allows three vehicles to stand side by side, and turning points can be established in the middle of long blocks, if necessary. The tonnage of the traffic in some of the business portions of Chicago rises to 15,000 tons per day, and is

accommodated in some places on a 30-foot roadway, but there is hardly a residence street in which the traffic exceeds ten tons in this same time, and yet with this tremendous difference in traffic, we find but little allowance for difference of width.

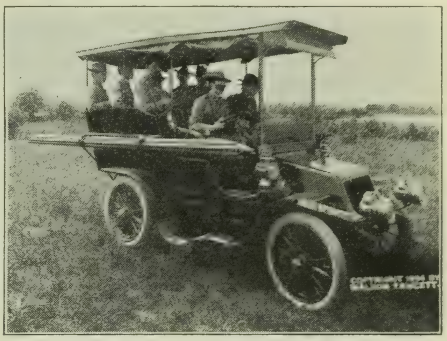
Asphalt itself is a variable material, the only reliable test of which is its action in the pavement. Such pavements have frequenty failed, but it is to be remembered that the industry is new and has been rapidly developed in less than thirty years to the point where there are now about 2,000 miles of street, representing an investment of over $100,000,000, in this country alone. The wearing surface of asphalt pavement is composed of ninety per cent of sand or mineral matter, the asphalt being the cement that binds it into a tenacious and elastic coating. If, for any reason, such as improper preparation, age, or volatilization, the cementing quality of the asphalt disappears, the pavement disintegrates, cracks, and is rapidly worn or broken down. The general tendency of asphalt pavement to decay will be indicated by its loss of elasticity, during sudden changes of temperature, cracks forming during cold weather, and particularly during extreme drops in the temperature.



Comparative Loads one Horse Can Draw on Different Roadways.

THE AUTO TELEGRAPH CAR.

The United States government has decided to make a practical trial of the usefulness of the automobile in modern warfare and to that end has just had constructed for the United States Signal Corps a high power motor vehicle known as an auto telegraph car and which is the only machine of its kind in the world. In this age the chief function of the Signal Corps is to erect military telegraph and telephone lines in order to keep communication open between forts or other headquarters and the forces in the field and it is in this service



"Only Machine of Its Kind in the World."

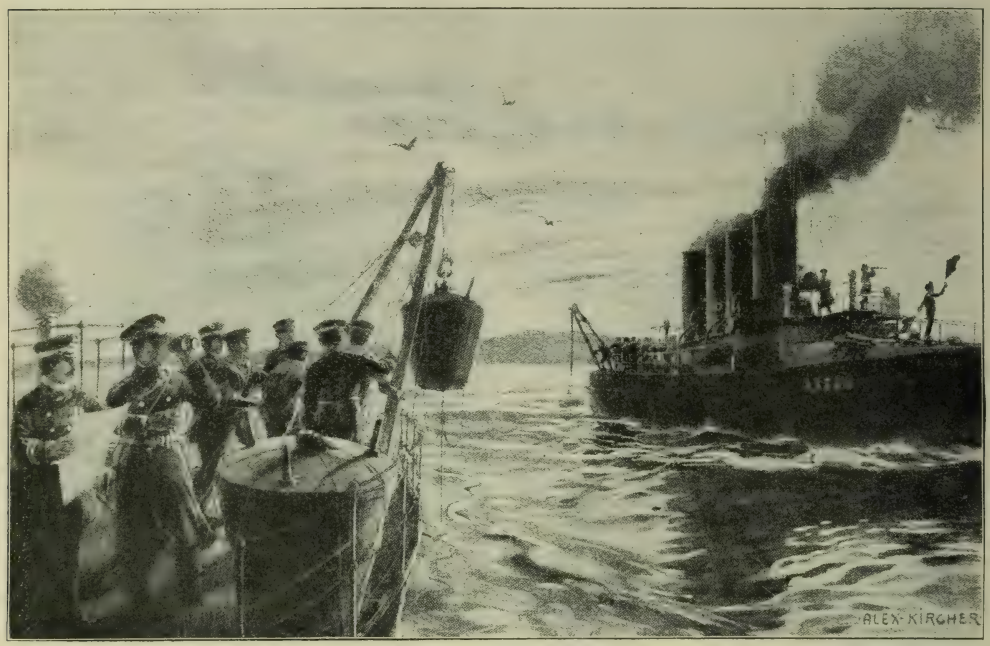
that the new auto car will be used. It is designed not only to facilitate the rapid erection of telegraph lines, but is also equipped for use as a field telegraph station.

The automobile itself is very similar to a heavy touring car of the Winton type with the exception that the ordinary style of tonneau has been replaced by a special tonneau with seats along the sides, the occupants of which face each other, and having ample storage space for instruments, and other equipment. At the sides are racks on which are carried lances or light poles for use in erecting a temporary overhead telephone or telegraph line when other supports are not available. The "flying telegraph office" is equipped with all the latest modern improvements, including "sounders," which make it possible to receive and transmit messages amid the din of battle. The regular automobile detachment comprises eight soldiers, six of which act as an armed guard for the operators.

Popular Mechanics makes a special subscription offer of five years for three dollars. Address may be changed at pleasure.

JAPANESE MINES THE TERROR OF RUSSIAN FLEETS.

The Japanese have been very daring in the matter of laying mines. Ofttimes they have watched their opportunities and done their work under the very noses of the Russian fleet at Port Arthur.



Japanese Torpedo-Boat Destroyers Laying Mines Outside Port Arthur.

One feature of this work was a most deadly explosive invented by one of their engineers. The inventor kept the nature of the explosive a profound secret, but while superintending the placing of a mine it exploded, and he was killed and the secret of his invention was lost with him, much to the regret of the Japanese.

SPEED IN WARSHIPS.

Is it worth while to sacrifice any naval qualities in warships for the sake of speed? This is the question that has been agitating the minds of French naval tacticians, says the Engineer of London, and one faction declares that the consideration of speed is secondary, citing the manner in which the "Gloire" class have all beaten the "Jeanne d'Arc" (two knots swifter) on trial and how the Japanese vessels "Tokiwa" and "Asama" failed to catch the slower Russian vessels "Gromoboi" and "Rossio." The five months' service, declare the French, had lowered the 22-knot speed of the Japanese vessels to 16 knots. An investigation reveals, however, that the Japanese vessels had cylindrical boilers while the Russian vessels were equipped with watertubes in perfect condition.

The English paper in refuting the stand taken against speed as an important element, declares: "The swifter ship always has the option of battle, and that means much, if not everything in modern warfare. The swift warship or fleet cannot, of course, be in two places at once, but it can certainly compel the enemy to have ships in two or three different places at once to waylay it. In fine, it is tolerably certain to compel the enemy to divide, and thus take risks of annihilation in detail.

"Difficulties there are, and must ever be. Mostly they are inherent in warships. For instance, the ocean liner is designed to run at a high speed regularly, rarely cruising at a low rate, whereas the warship usually goes slowly, but must be able to spurt her hardest at very short notice. From this cause troubles may arise now and again, but the navy whose ships can race on occasion is the navy that must rule the sea."

Brilliant Scenes at an English Yachting Festival

"The Scene at Night Was One of Beauty Beyond Description."

The annual yachting festival held at Cowes, Isle of Wight, during August, was a most brilliant affair. The king and queen graced the occasion and the weather was beautiful, a combination of affairs calculated to rejoice the average Englishman's heart.

Among the yachts which entered the races the German emperor's "Meteor" was very conspicuous because of the poor showing it made and the "Ingomar," owned by an American, Mr. Morgan Plant, was of interest because of the splendid speed made in the race for big yachts in which it won first prize. Most of the first prizes were taken by Englishmen.

The scene at night was one of beauty beyond description. Each yacht was brilliantly illuminated with myriads of incandescent lights, which the clear waters doubled and tripled, and the fireworks displays intensified the effect.

TO REMEDY ELECTROLYSIS IN ST. PAUL.

The escaping electric current from the rails of the street car lines in St. Paul has been attacking the underground water and gas mains for some years. The city authorities have insisted that some remedy be provided. The railway company have decided to lay copper wires between the double tracks, and lead these wires back to the power station. By frequent connection of these wires to the rails it is expected the escape of stray currents into the earth will be prevented. The cost of the wire and labor of installing will be $23,000. Work will commence at once.

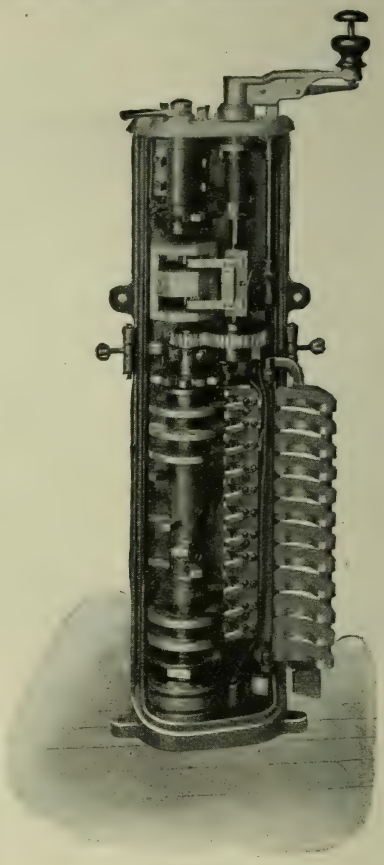
CONTROLLER ON A TROLLEY CAR.

The "Throttle" by Which the Motorman Turns on the Power

The popular idea of the controller of the electric car seems to be that it is an iron box containing a good deal of delicate mechanism which, in some incomprehensible manner, performs certain complicated functions, says the Electrical Review. Many, no doubt, think that the controller cover conceals electromagnets, gear wheels, rods, wires and other devices, all in imminent danger of flying to pieces when anything goes wrong. This is not true, for although the action of the controller may seem complicated to one who has not made a study of such devices, the mechanism of the controller is exceedingly simple. When anything happens to the controller, it is the controller itself which suffers. It is true that sometimes the motorman's clothing may be damaged under such circumstances by hot metal, but the passengers themselves, if they are where they belong, are in no danger. Every one appreciates the startling character of a brilliant electric arc suddenly appearing when and where least expected, but the electric arc is not dangerous to those who remain at a respectful distance.

The electric controller used on a street car may be compared with a water faucet, though, of course, the analogy must not be pushed too hard. Its function is to regulate the supply of current both in amount and in the way it flows through the car motors. It allows the current to flow first through a single path, and, by steps, reduces the opposition to this flow, thus allowing the current to increase. It then supplies two paths, as though two faucets were opened, and again by steps allows the current to increase through each of these paths.

For convenience in manipulation, all electrical connections, except such as are permanent, are made by the controller. Exception is made in the cases of the fuse and circuit-breaker, which are safety devices, and, for this reason, are separated from the controller and are isolated. The function of these two is to open the conducting circuit when the current flowing through the car is too great. Other than this they have no effect on the motors. An electric motor consists of two parts, each of which contains a winding of copper wire. The rotating part is called the armature, and the fixed part, the field. From each end of these two windings wires are carried to each of the car's controllers. Since there are two motors, there will thus be eight wires carried in a cable under the car floor and up through the platform floor to the controller. An additional connection



A Controller

may be made to the field winding, for the purpose of giving a greater range of speed, but this is not essential to the working of the car. Besides the car motors, there is under the car the so-called rheostat, a device for preventing the flow of excessive currents. This device is usually divided into two or three sections. When all of it is connected in the circuit, the greatest resistance is offered to the flow of current. As it is cut out by the controller, the resistance it offers decreases until it is finally all removed. Assuming two sections of the rheostat, there will then be three wires

carried from this piece of apparatus to each controller. There are two other wires, one by which connection is made to the trolley, and the other making connection through the car truck to the rails. In all, this makes thirteen wires led into each controller.

The function of the controller is merely to establish suitable electrical connections between these thirteen wires. When the controller handle is first turned, everything is connected, as we say, in series—that is, the current coming to the car from the trolley wire passes through the rheostat to the field winding of one motor, then through its armature, next to the field winding of the second motor, finally passing through its armature to the track. The next two or three moves of the controller handle merely cut out the rheostat in steps, just as though a faucet handle were given two or three turns, opening it wider to allow more water to flow. The next movement of the controller handle causes the current entering the car to pass first through the rheostat. It then has two paths by which it may reach the track—one through each motor. Further movements of the controller handle cut out the rheostat as before, leaving the two motors connected directly between the trolley and the rail by means of the wires running through the controller.

The movable part of the controller is an iron spindle, upon which is arranged a series of metallic discs insulated from the spindle. These discs are connected together in pairs, and they are partially cut away at the periphery, so that they represent a series of cams. On the back of the controller are a number of brass blocks supported on springs, which press each of them in contact with its corresponding disc whenever the projecting portion of the latter comes opposite to the contact block. To each of these blocks one of the car wires is connected. In this way the electrical connections just explained are made successively as the handle of the controller is turned. When the handle is at the off position, none of the contact blocks is touching the discs. There is, in addition, the reversing lever, which is placed in the controller box, but this is only operated when the regulating handle is thrown off, and it merely makes the necessary change in the method of connecting the motors so that the car may be run in either direction.

What happens when a controller breaks down, or, as the motorman would say, "blows out," is either that too large a current has been allowed to pass through some of the wires in the controller—a rare accident which should be prevented by the fuse; or, in throwing the controller to the off position, which should break the current, the latter has instead jumped from one contact block to another, or to the frame of the controller. This produces what is called a short-circuit—that is to say, a path offering little resistance to the flow of current from the trolley wire to the track. This arc may cause more or less damage to the wires and metal of the controller before it goes out, but the damage is usually slight and is confined to a small spot. It is to be expected that the average passenger on an electric car is startled when something goes wrong, with a bright flash and a loud report, but he is learning rapidly that this does not signify danger, and that he is safest if he sits still. On the other hand, electrical apparatus is being improved rapidly, so that such accidents are becoming rare. In some of the latest types of controlling systems the main motor current does not pass through the controllers—in fact, it at no time in its passage is above the car floor.

FIREMEN TO QUALIFY AS ENGINEERS.

Two big railway companies, the Lake Shore and the New York Central, have decided that in order to secure competent engineers and to weed out incapable firemen, they will educate their firemen in conjunction with their daily duties to become engineers. More than that, the fireman who will not take the education will lose his job.

In the first year of his service the fireman will receive a book of rules pertaining to the mechanical and fuel phases of a locomotive. If he fails to make a good grade when examined at the end of a year he will be dropped from the service. The course covers three years and a grade of 80 per cent secures a diploma as a qualified engineer. The examining board, however, require a grade of 100 per cent.

The English telegraph service, which is a branch of the postal department, had a deficit last year of $4,500,000. This is partly due, however, to extensions and maintenance of newly established lines not yet self-sustaining. Last year over 83,000,000 messages were handled.

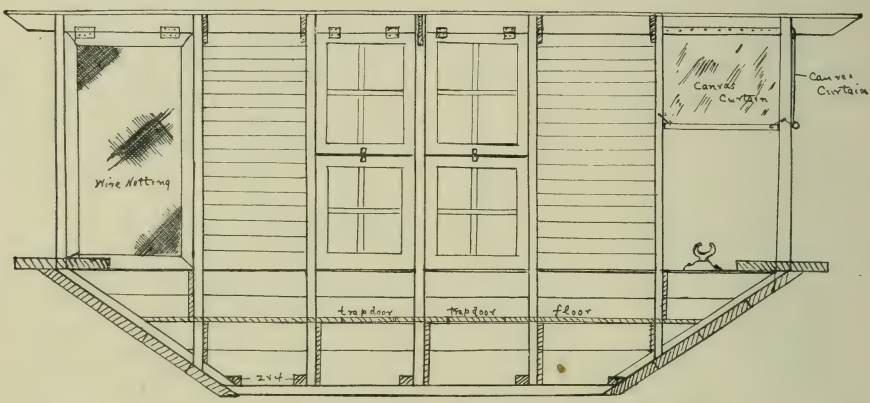
HOUSE-BOAT TRIP FROM CHICAGO TO ST. LOUIS.

Editor Popular Mechanics: I send you a rough sketch showing a longitudinal section of a house-boat in which I recently completed a trip from Chicago to St. Louis. Those of your readers who live along the Illinois or Mississippi rivers will no doubt think this a crude craft of its kind, but to the inland boys it will convey a fair idea of how to build a house-boat cheaply in which just as much fun can be had as in a more pretentious craft. This boat is 24 feet long, 6 feet wide and 10 feet high, and the lumber in it cost $60 in Chicago. The hull is built of 2x10 pine dressed, and the seams calked so that she never leaked a drop. The studding and bracing is all 2x4 except in the corners, where 4x4's were used. The cabin, 14 feet by 10 feet, had a door at each end and double windows on each side, the upper sash being hinged and the window openings are covered with wire netting on the outside, the sash swinging inwardly and hooked up to the ceiling. At the stern where we had our gasoline stove, wire netting on hinged frames with canvas curtains formed a perfect protection from flies, mosquitoes and wind. At the bow or front end, where we used our oars for propelling and guiding the boat, we had canvas curtains which could be adjusted at any height and set at an angle like regular awnings.

The hull was built deep so as to withstand any waves that we might encounter in the river from storms or passing steamers. The floor is 18 inches below the hull line, and the space under the floor is used for storing ice and supplies; trap-door affording ready access thereto.

The bunks (not shown) were the ordinary woven wire mattress frames, hinged at their inner corners to the uprights or studding and supported at their outer corners by chains, the inner ends of which were connected to staples driven in the 2x4's, so that during the day the bunks were folded back against the wall and held so by hooks, thus leaving the entire floor space of the cabin free for table and chairs. At night the table and chairs were folded and the bunks let down.

The roof was 10-ounce canvas covered with three coats of good lead paint, but a cheaper roof could have been made with matched boards covered with tarred paper. Common mosquito netting could be substituted for the wire netting. The hull and the roof are the essential features and must be tight. We used common siding for the sides and ends and did not line the cabin. An important point is to have as much "rake" as possible, thus causing the boat to ride the waves easily.



Side Elevation of House-Boat

In this boat we drifted, rowed and were towed through the Illinois and Michigan canal from Chicago to La Salle, Ill., where we ran into the Illinois river, which we traversed to Grafton, Ill. (near Alton), where we struck the "Father of Waters," who carried us along at the rate of seven miles an hour to St. Louis, the entire trip taking just three weeks. So enamored have I become of house-boat life that I shall build a larger craft, equip it with a paddle-wheel and a gasoline engine, launch it in Lake Michigan and use it for summer outings in the streams along the eastern shore of the lake.

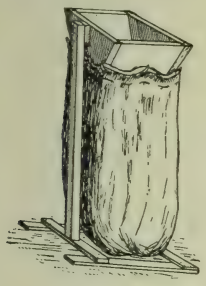
F. B.

Have you seen "Shop Notes?"

SHOP NOTES

HANDY HOME-MADE BAG-HOLDER.

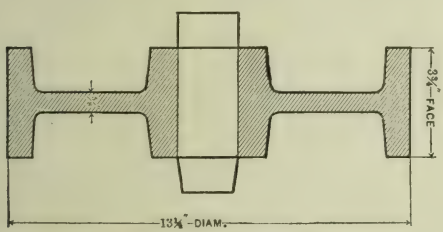
A firm standard supporting a wooden hopper of convenient size and provided with iron hooks on which to hang the bag constitutes this convenient bag-holder. Any workman, shop-keeper or farmer can build it out of a few pieces of wood with little trouble and no expense and will find it a time and temper-saving device forever afterward.



MAKING A FRICTION WHEEL PATTERN IN SHORT TIME.

A customer wanted a friction wheel and two castings made in a hurry one afternoon, says a correspondent of The Patternmaker, and the pattern was rushed out in one hour and twenty minutes by the following method:

"Planed out a piece the right thickness for web, bored a small hole through at center for divider points and struck a circle on each side to nail segments to. Sawed four segments for each side accurately to line on inner diameter and to the right bevel for draft. Sawed a hub for each side with proper draft. Sawed two sets of prints, one 2 inches in diameter, one 1¼ inches in diameter. Segments were nailed to each side of web, drag hub nailed on carefully in

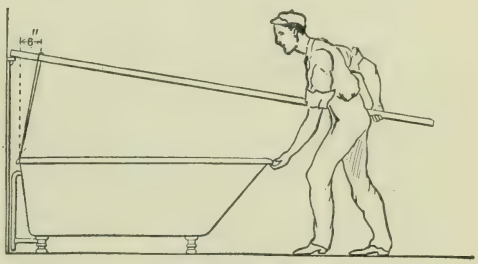


Emergency Pattern.

center, measuring from inside diameter of segments. Outside diameter of wheel was then marked from this hub center and the outside of entire wheel sawed with proper draft. A ⅜ dowel was put in center of loose hub and dowels in center of all prints and holes bored in hubs to match, so that molder could change them at foundry. Saw was in excellent order and no sandpapering was done. Putty fillets were put in, a coat of varnish was put on and the pattern sent to the foundry.

HOW ONE MAN MOVED A BATHTUB IN A TIGHT CORNER.

Disconnecting and resetting a 6-foot porcelain enameled bathtub, the foot end of which stood in a close-fitting recess for a distance of two feet, is hardly a job that any plumber would care to tackle alone, but a correspondent of the Metal Worker, Plumber and Steam Fitter tells how he did it.



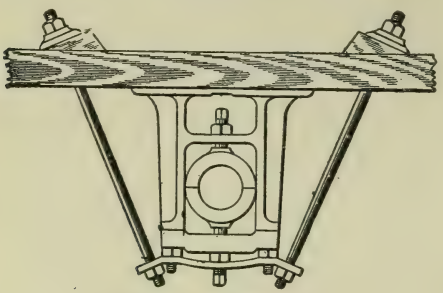
Moving a Bathtub.

A small block of wood was fastened to the cap of the wainscoting by means of brads. Bearing on this was placed one end of a 2x4-inch scantling about 10 feet long, place edgewise. A loop of sash cord was passed around the double bath bib and the scantling, while the further end of the scantling rested on the rim at the head end of the tub. Standing at the head end of the tub, and raising the end of the scantling with the right hand, the foot end of the tub was easily lifted. With the left hand lifting the rim of the tub at the head end, the tub swings clear, and may be moved to either side or endwise at will. The endwise movement is obtained by shifting the loop of rope out of the perpendicular on the scantling in either direction.

The bathtub when lifted with the rope in the position shown in the sketch will move six inches toward the plumber.

REINFORCING A SHAFT HANGER.

Irregular impulses from the engine will often cause shafting to break down, causing much damage and endangering lives. The method here shown of reinforcing the shaft hanger was used by a correspondent of the Engineer, and effectually overcame the

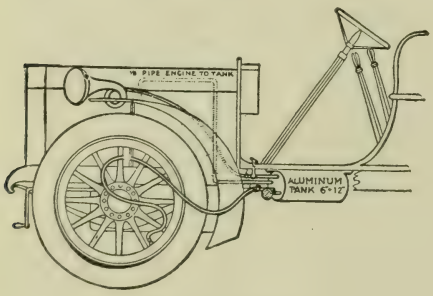


Reinforced Shaft Hanger.

trouble with a length of 4-inch shafting. In a shaft hanger the tension should all be taken by steel or wrought iron, and cast iron should be used only to give rigidity.

AN AUTOMATIC HORN BLOWER AND TIRE INFLATER.

A new device for automatically blowing automobile horns and inflating tires consists of a small aluminum tank, 6 inches in diameter and 12 inches long, which is connected with the cylinder of the gasoline motor by a pipe containing a check-valve. The opening is exceedingly small. When



Automatic Horn Blower.

an explosion takes place a minute quantity of gas finds its way into the tank, where it is kept under pressure until wanted for use. By pressing a foot button a whistle can be blown, and a hose connection is provided for inflating tires. The same outfit is used with some modifications, for sounding whistles in motor boats.

ESTIMATING THE HORSEPOWER OF STEAM ENGINES.

When steam engines were first introduced they were largely used to take the place of horses, previously employed for raising water from mines. Naturally the people would inquire, when buying an engine, what amount of work it would perform as compared with horses. The earliest engine builders found themselves very much at a loss to answer these questions. Their first business, therefore, was to ascertain how much a horse could do.

The most powerful draught horses and the best of any then known were the London brewers' horses. These, it was ascertained, were able to travel at the rate of two and a half miles per hour and work eight hours per day. The duty in this case was hoisting a load of 150 pounds out of a mine shaft by means of a cable. When a horse moves two and a half miles per hour, he travels 220 feet in a minute, and, of course, at the speed named, the 150-pound load would be raised vertically that distance. That is equal to 300 pounds lifted 110 feet per minute, or 3,000 pounds lifted 11 feet, or 33,000 pounds one foot high in one minute. That is the standard of horsepower, as we all know. It is much more, however, than the average horse can do, and therefore the engine builders were confident that the engines would take the place of fully as many horses as the horsepower would indicate that they should.

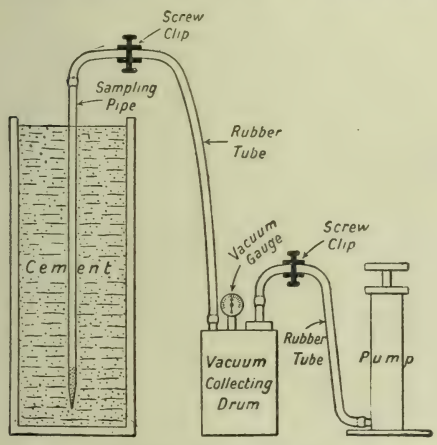
Of course, 33,000 pounds lifted 1 foot per minute is much more convenient for calculation than 150 pounds lifted 220 feet, and therefore the former has been adopted. The amount of work, or number of foot pounds, is the same in either case. A foot pound represents the amount of power required to lift one pound one foot high. To find the number of horsepower in any engine, we multiply the area of the piston by the average pressure per square inch upon the piston, multiply this result by the distance which the piston travels per minute in feet, and the result is the number of foot pounds per minute which the engine can raise. Divide by 33,000 and the result will be the number of horsepower. The number of feet per minute traveled by the piston is twice the number of strokes per minute multiplied by the length of the stroke. This gives the number of horsepower sufficiently accurate for all practical purposes.

J.M. Bulkley.

MACHINES FOR SAMPLING CEMENT.

An English device, lately patented, takes a sample of cement from any given batch with great simplicity of operation and accuracy.

The apparatus consists first of a small iron pipe some ⅜ inch in bore, with one end closed and drawn to a point. The other end is open, and to it can be attached a length of rubber tubing. The pointed end of the pipe has a number of small holes pierced in it, and to take a sample this tube is thrust into the heap of cement. It may be pushed in at any angle from vertical downwards. The india-rubber tube above referred to is connected to a drum provided with an opening covered with a screw cap, the whole being made air-tight. The apparatus is completed by means of an exhausting pump which may either be worked by hand or by a small motor. In the apparatus first tested an ordinary hand and foot pump was used. It was also connected to the drum by a length of rubber tubing. Each length of rubber tubing was provided with a screw slip, which could be



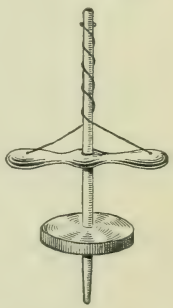
Cement Sampling Apparatus.

made to nip the tubing so tightly that no air could get past. In the tests the heap of cement was represented by a vertical box, some 9 inches square, and filled with cement to a depth of nearly 6 feet. This is about the limit of depth to which the apparatus may be applied with success, but a depth of 6 feet is ample for all practical purposes.

In sampling the iron pipe was plunged nearly to the bottom of the box of cement. The amount of cement which is forced through the small holes in the lower end of the pipe during this process is so small that it may be neglected. The clip on the rubber tube joining the sampling pipe with the drum was then screwed up. A man then worked the pump, and exhausted the drum until a vacuum equal to some 18 or 20 inches of mercury had been produced, when the clip on the tube between the drum and the pump was screwed up, so that any tendency to leakage through the pump valves might be counteracted. The drum had fitted to it a gauge, so that the amount of vacuum in it might be readily seen. The clip on the tube between the sampling pipe and the reservoir drum was then unscrewed, with the result that a certain amount of cement was drawn through the small holes in the sampling pipe, up through the latter, and then conveyed thence through the rubber tube to the reservoir. The whole process takes but a minute or two, and the amount drawn into the reservoir varies with the vacuum produced. In the tests several pounds of cement were drawn over each time. Several samples may be taken if desirable, and the whole operation requires but half an hour.

DRILLING HOLES IN GLASS.

One of our readers, Frank F. France, Plattville, Wis., writes: I see in your August number an article on how to bore holes in glass. Another way which I have used is to just make a pump drill, as in illustration, then lay the glass on a level table and lay a board over the glass. The board must have a hole bored just the size you want your hole in the glass; then lay the board on the glass with the hole in the board over the spot and clamp to the table so it is solid, then put a small pinch of sand in the hole in the board and drill part way on each side and you will have the hole in the glass. Remember the oak stick in the drill is almost the same size as the hole in the board. Put fresh sand in the hole frequently.



HOW TO SOFTEN FILES.

To soften small files cover them with oil and hold them over a fire until the oil blazes. As soon as the flame runs all over the file, plunge it into water.

ROPE HOISTS FOR HANDLING SHAFTING.

When lowering shafting by means of rope if it is necessary to come to a rest at any point in the proceedings there are several

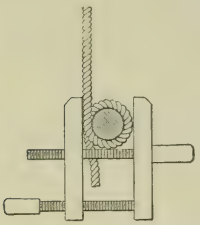


Fig. 1. Clamping a Rope Suspending a Shaft.

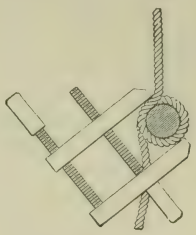


Fig. 2. The Probable Result.

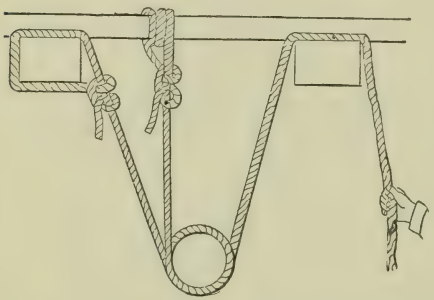


Fig. 3. Lowering With a Safety Rope Added.

ways of clamping it, but some are not as safe as they may at first appear.

Fig. 1 shows a method of clamping the rope to the shaft which is not to be depended on for the probable result is shown in Fig. 2. Against the peculiar pull made by a heavy shaft while being lowered it is to be doubted whether any wooden clamp yet devised would hold, says a correspondent of the American Machinist.

Fig. 3 shows a safe and easy method of holding the shafting at any point. If there is only one pulley on the shaft, two safety lines may be used, one at each end and the rolling hoist rope in the middle.

If the piece to be hoisted is exceptionally heavy and lacking a pulley large enough to serve as a hoist lever, any bar or piece of timber may be used as shown at Fig. 4.

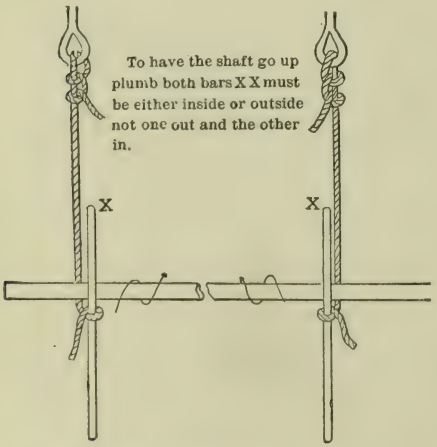


Fig. 4. Hoisting With Two Ropes.

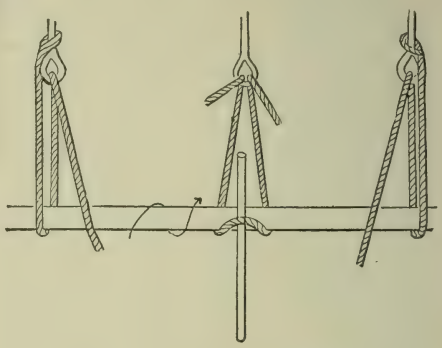


Fig. 5. One Hoist and Two Safeties.

If the center hoist and two-end safety-line way is used, with a bar or even a pulley, try to make it work centrally, as shown by Fig. 5.

Where an extra large and heavy pulley countershaft is to be hung on a very high ceiling and rolling must be resorted to, for lack of head room or suitable tackle, the inadvisable, because most hazardous, rolling from ladders can be done away with as in Fig. 6. The hangers being up, place the stripped shaft in the bearings and adjust the collars. Tie a rope's end to the pulley on the floor, pass the other end over the

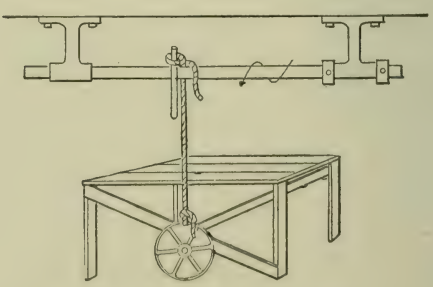


Fig. 6. Hoisting With a Scaffold.

shaft, run a bar through a bow-line in the rope and hoist the pulley to the staging from which the counter was put up. When everything is on the scaffold take the shaft out, assemble the counter and hoist it into place the rest of the way in the regular manner.

BORING HOLES IN GLASS.

Holes of any size desired may be bored in glass by the following method: Get a small 3-cornered file and grind the points from one corner and the bias from the other and set the file in a brace, such as is used in boring wood. Lay the glass in which the holes are to be bored on a smooth surface covered with a blanket and begin to bore a hole. When you have made a slight impression on the glass place a disk of putty around it and fill with water to prevent too great heating by friction. Continue boring the hole, which will be as smooth as one bored in wood with an auger. Do not press too hard on the brace while boring.

AN EXCELLENT SOLDERING SOLUTION.

For general soldering and for soldering galvanized wire points in particular, the Telephone Journal gives the following recipe:

"Take a wide necked, 6 ounce bottle, and pour in about 2 or 3 ounces of hydrochloric acid. Drop into the bottle a dozen or two small pieces of zinc, preferably granulated and wait until all ebullition ceases. In using either a solution or a stick flux, apply the heat to the middle of the joint, as the solder must run there first to obtain strength and solidity. Too much heat will anneal the wire and weaken the line. Wipe the joint free of all acid after soldering, or corrosion will follow."

HOW TO MAKE A USEFUL SOFT ALLOY.

A soft alloy which will adhere tenaciously to metal, glass or porcelain, and can also be used as a solder for articles which cannot bear a high degree of heat, is made as follows:

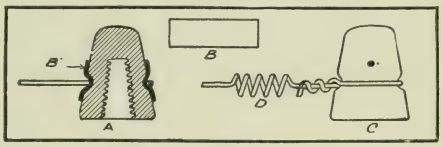
Obtain copper-dust by precipitating copper from the sulphate by means of metallic zinc. Place from 20 to 36 parts of the copper-dust (according to the hardness desired) in a porcelain-lined mortar, and mix well with some sulphuric acid of a specific gravity of 1.85. Add to this paste 70 parts of mercury, stirring constantly, and when thoroughly mixed, rinse the amalgam in warm water to remove the acid. Let cool from 10 to 12 hours, after which time it will be hard enough to scratch tin.

When ready to use it, heat to 707 degrees F. and knead in an iron mortar till plastic. It can then be spread on any surface, and when it has cooled and hardened will adhere most tenaciously.

TO STOP THE HUMMING OF WIRES.

The humming sound made by telephone lines is often very annoying and there are two easy methods of stopping it, says the American Telephone Journal.

Take a piece of rubber, B, long enough



To Keep Wires from Humming.

to go around the insulator and place it in the groove, as shown at B', Fig. A. Put on the wire and fasten in the usual manner.

Another method is shown in Fig C. Make a spiral of line wire about 2 feet long, D, and arrange it about 10 feet from the insulator. This takes the strain off the insulator during a high wind, also.

UMBRELLA JOINTS NEED OIL.

One never thinks of bestowing any especial care on his umbrella, and that is the reason the ribs break in a strong wind when the owner least expects it. The joints of an umbrella should be oiled first with coal oil or kerosene to clean off the rust, and then lubricating oil should be applied to make them work easily.

A GOOD QUICK-DRYING CARRIAGE VARNISH.

Boil together for four hours 8 pounds of fine pale gum anime, 2 gallons of clarified oil and 3½ gallons of turpentine. Strain, put into the two former pots and mix well together. It will cause the paint to dry more quickly and firmly and will enable it to take on polish quickly.

Knots and Miles.

Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles
1.00	1.1515	6.00	6.9091	11.00	12.6667	16.00	18.4242	21.00	24.1818
1.25	1.4394	6.25	7.1970	11.25	12.9545	16.25	18.7121	21.25	24.4697
1.50	1.7273	6.50	7.4848	11.50	13.2424	16.50	19.0000	21.50	24.7576
1.75	2.0152	6.75	7.7727	11.75	13.5303	16.75	19.2879	21.75	25.0455
2.00	2.3030	7.00	8.0606	12.00	13.8182	17.00	19.5758	22.00	25.3333
2.25	2.5909	7.25	8.3485	12.25	14.1061	17.25	19.8636	22.25	25.6212
2.50	2.8788	7.50	8.6364	12.50	14.3939	17.50	20.1515	22.50	25.9091
2.75	3.1667	7.75	8.9242	12.75	14.6818	17.75	20.4394	22.75	26.1970
3.00	3.4545	8.00	9.2121	13.00	14.9697	18.00	20.7273	23.00	26.4848
3.25	3.7424	8 25	9.5000	13.25	15.2576	18.25	21.0152	23.25	26.7727
3.50	4.0303	8.50	9.7879	13.50	15.5455	18.50	21.3030	23.50	27.0606
3.75	4.3182	8.75	10.0758	13.75	15.8333	18.75	21.5909	23.75	27.3485
4.00	4.6061	9.00	10.3636	14.00	16.1212	19.00	21.8788	24.00	27.6364
4.25	4.8939	9.25	10.6515	14.25	16.4091	19.25	22.1667	24.25	27.9242
4.50	5.1818	9.50	10.9394	14.50	16.6970	19.50	22.4545	24.50	28.2121
4.75	5.4697	9.75	11.2273	14.75	16.9848	19.75	22.7424	24.75	28.5000
5.00	5.7576	10.00	11.5152	15.00	17.2727	20.00	23.0303	25.00	28.7879
5.25	6.0455	10.25	11.8030	15.25	17.5606	20.25	23.3182	25.25	29.0758
5.50	6.3333	10.50	12.0909	15.50	17.8485	20.50	23.6061	25.50	29.3636
5.75	6.6212	10.75	12.3788	15.75	18.1364	20.75	23.8939	25.75	29.6515

Table Showing Knots Reduced to Miles.

A nautical mile or knot is 6,080.27 feet. For the benefit of those who are interested in the speed of sailing craft of all kinds, the Motor Boat has compiled a table of ready reference in which the various number of knots are reduced to land miles. The table will save a lot of figuring which would otherwise be necessary.

HOW TO CALCULATE SPEED.

To find the speed of a countershaft, if the revolutions of the main shaft and size pulleys are given: Multiply the revolutions of the main shaft by the diameter in inches of the pulley, and divide by the diameter in inches of the pulley on the countershaft; the quotient will be the number of revolutions, says the Practical Engineer.

Example:—What will be the speed of a countershaft with a 12-inch pulley, driven by a 30-inch pulley 180 revolutions per minute? $180 \times 30 \div 12 = 450$.

To find the size of a pulley required, if the number of revolutions and size of pulley on the main shaft are given: Multiply the diameter in inches of driving pulley by the revolutions of the main shaft, and divide by the speed required; the quotient will be the diameter in inches of the pulley.

Example.—What will be the diameter of a pulley to make a countershaft turn 450 revolutions per minute, driven by a 30-inch pulley 180 revolutions per minute? $180 \times 30 \div 450 = 12$-inch pulley.

To find the size of a pulley for a main shaft if the speed of shafts and diameter of the pulley on the countershafts are given: Multiply the diameter in inches of pulley by speed of the countershaft, and divide by the revolutions of the main shaft; the quotient will be the diameter of pulley.

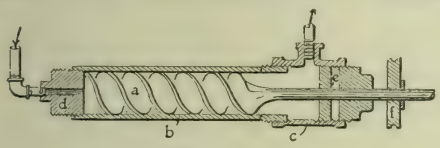
Example.—What will be the diameter of a pulley on a main shaft making 180 revolutions per minute to drive 12-inch pulley 450 revolutions per minute? $450 \times 12 \div 180 =$ 30-inch pulley.

A BLACK PAINT FOR IRON.

A good cheap black paint for iron work is prepared as follows: Solid wood tar, 10 pounds; lampblack or mineral black, 1¼ pounds; oil of turpentine, 5½ quarts. The tar is first heated in a large iron pot to boiling, or nearly so, and the heat is continued for about four hours, says Lead and Zinc News. The pot is then removed from fire out of doors, and while still warm, not hot, the turpentine mixed with the black is stirred in. If the varnish is too thick to dry quickly, add more turpentine. Benzine can be used instead of turpentine, but the results are not so good. Asphaltum is preferable to the cheap tar.

HOW TO MAKE A ROTARY OIL PUMP.

A rotary oil pump is simply and easily made. Place a ¾-inch auger bit (a), such as carpenters commonly use, inside a piece of ¾-inch brass pipe (b). Make connection at d by a plug turned down, threaded



A Rotary Pump.

and screwed into the threads cut into the end of the pipe and by the wall tee (c). Make a stuffing box (e) by sawing a plug in two parts and drilling a hole for the shank of the auger; f is the pulley belt. The pump should be driven at about 500 to 1,000 revolutions per minute, says Power.

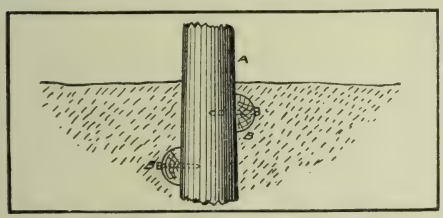
A GOOD RECIPE FOR HEAT-PROOF PAINT.

A good cylinder and exhaust pipe paint is made as follows:

Two pounds of black oxide of manganese, 3 pounds of graphite and 9 pounds of terra alba, thoroughly mixed. Add a compound of 10 parts of sodium silicate, 1 part of glucose and 4 parts of water, until the consistency is such that it can be applied with a brush.

UNDERGROUND BRACES FOR POLES.

In constructing telephone lines there are sometimes places where it is impossible to support a pole with guy wires. To meet this difficulty, says the American Telephone Jour-



Bracing Poles Without Guy Wires.

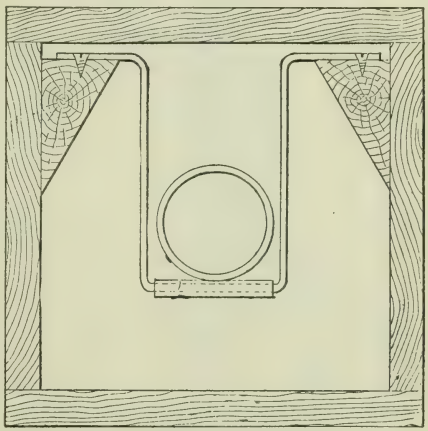
nal, underground pole braces are the proper support.

Two logs, B B, about five feet long, are shaped as illustrated and then bolted to the pole; the earth is then thoroughly tamped around them. A filling of stone will secure the logs much more firmly and in marshy ground this method of construction would be in a great degree successful.

When the logs are used in place of guy wires they should be placed as nearly at right angles to the direction of strain as possible, to secure the best results.

SUPPORTS FOR UNDERGROUND STEAM PIPE.

The following method of supporting underground steam pipe is highly recommended by a correspondent of Power: The pipe rests on a roller. A piece of iron rod of the proper length is selected and passed through a piece of iron pipe about the length of the diameter of the steam pipe; the iron rod is then bent and fastened as shown.



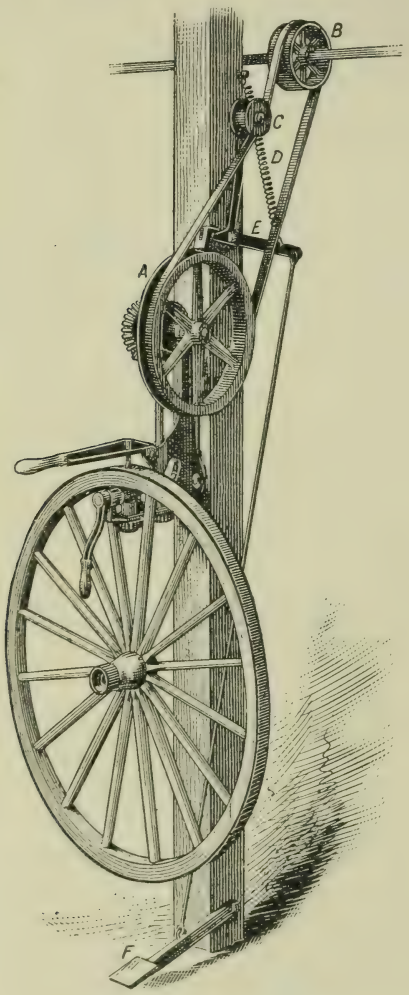
Laying Steam Pipe Underground.

Steam pipe for underground use should be carefully selected and the joints well made to prevent leakage; it is a good plan to use a mixture of graphite and cylinder oil in screwing up the connections. The best covering is made by laying cement mortar in the bottom of the trench and pressing into it a V-shaped wooden box, into which the pipe is laid. Over this place another wooden box and cover the whole with cement mortar, laying the bottom, top and sides of the cement all at the same time, so that one part will not set before another. The cement should set thoroughly before the steam is turned on. When there are bends in the pipe it should be provided with expansion joints and stop valves.

When cutting rubber sheets (sheet packing) dip the knife in water frequently and the work will be more easily done.

A HANDY TIRE BOLTER.

Twice the amount of work one can do by hand can be done by the use of the tire bolter here shown, says a correspondent of the Blacksmith and Wheelwright. The machine is run with a 1½-inch loose belt and a tightener and a 5-horsepower gasoline engine for power.



Attaching Power to a Tire Bolter.

Referring to the figure: A is a 16-inch pulley with a 3-inch face and two bands of 1x¼-inch iron shrunk around the edge of the wheel to keep the belt from slipping. B is an 8-inch drive pulley with a 4-inch face. C is the tightening pulley, three inches in diameter and having a 4-inch face with a flange on each edge. D is a spring that regulates the tightener and the brake. E is the brake that prevents the machine from turning when not at work. F is the treadle which is used to regulate the speed.

THE USE OF BAYBERRY WAX IN PATTERN MAKING.

The finishing of metal patterns is quite a question, especially in shops where a comparatively small number are made. Bronze patterns retain a very good surface without the use of any lacquer whatever, but in the case of iron patterns it is necessary to provide some coating for the surface of the pattern, says the Pattern Maker. If the iron is thoroughly cleaned and then coated with a solution made by dissolving bayberry wax in benzine or gasoline, it will be found that as the benzine or gasoline dries off it leaves a good firm coating of the wax, which gives a good surface and one that will wear well.

PAINT FOR WOOD OR STONE THAT RESISTS ALL MOISTURE.

The following recipe for a waterproof paint for wood or stone is given in the Architect and Builder:

Melt 12 ounces of resin; mix with it thoroughly 6 gallons of fish oil and 1 pound of melted sulphur; mix some ochre or any other coloring substance with a little linseed oil, enough to give it the right color and thickness; apply several coats of the hot composition with a brush. The first coat should be very thin.

HOW TO MEND RUBBER ARTICLES.

Clean off any particles that may adhere to the rubber and then dry the article or piece thoroughly. Emery paper or a file will remove varnish from rubber, and the part from which the varnish has been removed should then be rubbed over with benzine. Paint the edges of the hole with a solution of Para caoutchouc in benzine and lay over it a strip of natural rubber to fit. Then apply to the edges a solution of 400 parts of benzine, 300 parts of carbon disulphide, and 18 parts of sulphur chloride. Apply by means of some cotton wool tied to a wooden holder. The solution will vulcanize and increase the resistance of the rubber. Press the joined parts closely together.

MECHANICS FOR YOUNG AMERICA

HOW TO MAKE A HECTOGRAPH.

A hectograph is very simply and easily made and by means of it many copies of writing can be obtained from a single original.

Make a tray of either tin or pasteboard, a little larger than the sheet of paper you ordinarily use and about ½-inch deep. Soak 1 ounce of gelatine in cold water over night and in the morning pour off the water. Heat 6½ ounces of glycerine to about 200 degrees F. (93 C.) on a water bath, and add the gelatine. This should give a clear glycerine solution of gelatine.

Using the Hectograph.

Place the tray so that it is perfectly level and pour in the gelatinous composition until it is nearly level with the edge of the tray. Cover it so the cover does not touch the surface of the composition and let it stand six hours, when it will be ready for use.

Make the copy to be reproduced on ordinary paper with aniline ink; using a steel pen, and making the lines rather heavy so they have a greenish color in the light. A good ink may be made of 1 ounce of aniline (2 R B or 3 B) dissolved in 7 fluid ounces of hot water. Cool and add 1 fluid ounce of glycerine, a few drops of ether and a drop of carbolic acid. Keep in a corked bottle.

When the original copy of the writing is ready moisten the surface of the hectograph slightly with a sponge, lay the copy face down upon it and smooth down, being careful to exclude all air bubbles and not shifting the paper. Leave it nearly a minute and raise one corner and strip it from the pad, where will remain a reversed copy of the inscription.

Immediately lay a piece of writing paper of the right size on the pad, smooth it down and then remove as before. It will bear a perfect copy of the original. Repeat the operation until the number of copies desired is obtained or until the ink on the pad is exhausted. Fifty or more copies can be obtained from a single original.

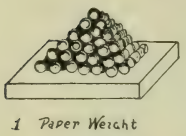
When through using the hectograph wash it off with a moist sponge, and it will be ready for future use. If the surface is impaired at any time it can be remelted in a water bath and poured into a tray as before, if it has not absorbed too much ink.

USEFUL ARTICLES AND ORNAMENTS MADE OF OLD BICYCLE PARTS.

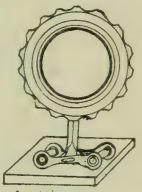
A great deal of pleasure may be derived from turning parts of old bicycles into articles of use or ornamentation. Many original ideas can be used in this work and it is good practice for the boy of an inventive turn of mind. Sprocket gears, cone shafts, handle bars, wheel rims and other parts of old bicycles which were formerly disposed of as junk, are now carefully assorted, cleaned, polished or nickel plated, and used for wall and archway decorations. Plating outfits are expensive, but persons who possess them will do that part of the work for a small charge.

An idea of the character of the articles obtainable from cast-off bicycles is shown. Figure 1 is a collection of balls from several ball bearings, formed into a pyramid by means of cement, and nickle plated or gilded. The pyramid is then cemented to a wooden base and forms a useful desk paper weight. A table mirror (Fig. 2) is made by fastening a circular mirror to the center of a wheel sprocket gear; the stand is a pedal and pedal shaft. The pedal shaft is screwed tight to the pedal and consequently keeps the affair perpendicular. The sprocket, pedal and shaft are bronzed or plated and if desired, the sprocket may be wound with

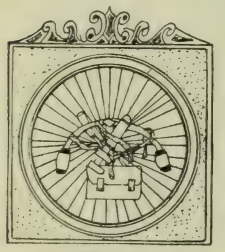
fancy ribbon. Fig. 3 is an old wheel, the tire of which is filled with sawdust to keep it expanded, and in the center of which are several mementos of a by-gone cycle season, and all are hung to the wall. The tire of the wheel is artistically ornamented with oil or water colors or coated with silver bronze. The spokes are polished and the central articles are nickel plated, making an attractive showing. Another wall decoration of this order is shown at Fig. 4, in which the wheel tire is treated as before and prepared for a figure head or ordinary picture or wall mirror to be attached to the spokes. Fig. 5 is a pedal crank, plated and entwined with colored ribbons for hanging up. Memories of last season's wheeling are brought to mind by such designs as in Fig. 6. This is a spider, plated or gilded, and secured to a wooden base. There are pins beneath on which part of a chain is suspended. Perhaps this chain has a story



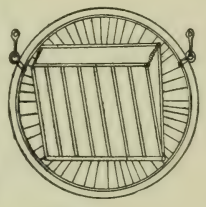
1 Paper Weight



2: Mirror

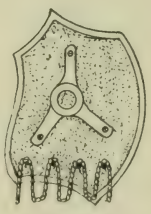


3: Frame

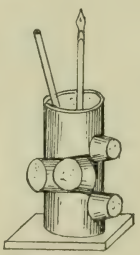


4: Rack

5: Ornament



6: Ornament



7: Holder

connected with it. It is finely polished or nickle plated and makes a memento of a bicycle which in its day had no equal in the estimation of its owner. The wooden base is either sanded or finished in natural state. Fig. 7 is a crank hanger separated from the tubes, japanned or bronzed, and used for a pencil and pen holder. Fig. 8 is a piece of hall furniture from which the hat

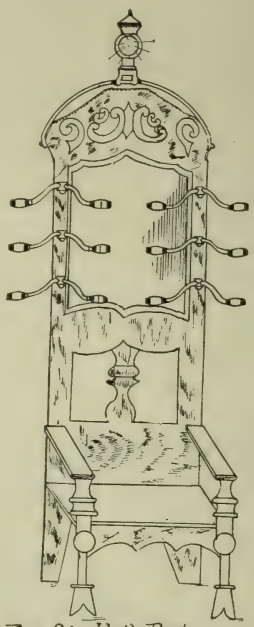


Fig 8: Hall Rack

Fig 9: Seat

pins are removed and bicycle handle bars substituted. This is done by simply putting the bar posts through the original pin holes and securing the posts on the back by means of clamps. A cycle lantern is placed at the top, with fork and head piece, by expanding the fork and prongs to conform to the shape of the top. A set screw is put into the wood through the shaft holes in the forks and the whole affair is firmly held in place. The lantern can be kept in order and lighted. By cutting off the rear of the frame at the juncture of the seat pot lug and the crank hanger, a hall stool or seat can be made as in Fig. 9. The rear stays are spread out to form the necessary standing support for the affair. The tubing is re-enamelled or japanned and the bright work polished, while the saddle leather is treated to a surfacing of gold or silver composition, making an attractive and useful piece of hall furniture.

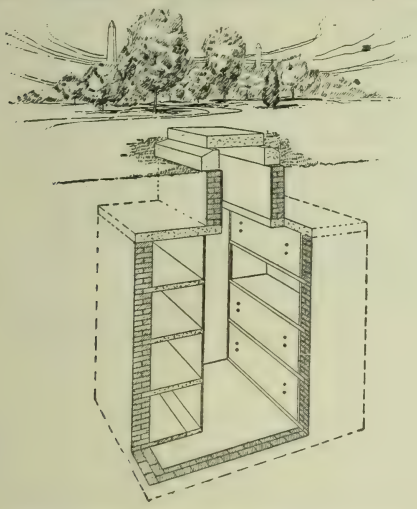
In 780 of the Southern Pacific Railway's 1,350 locomotives oil is used as fuel. In the shops at Sacramento, also, oil is used instead of coal.

Underground Vaults

New Method of Burial Recommended by Large Cemetery Companies

Brick graves, grave vaults and large underground vaults having a number of crypts are becoming common in many of the cemeteries of our large cities. In such places the mortality is always great and while the vault represents to bereaved persons means of ridding death of some of its horror, it finds favor with cemetery companies, because its use economizes space.

Many of these graves and vaults have been built in West Laurel Hill cemetery, Philadelphia. Single graves are built up of either common or enameled brick, have

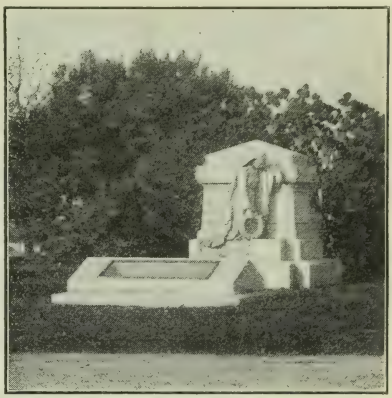


Plan of Vault Having Eight Crypts and Shaft.

floors of brick or stone, and are covered with a slab or several slabs as wished; sometimes the grave is built up double with or without a partition between.

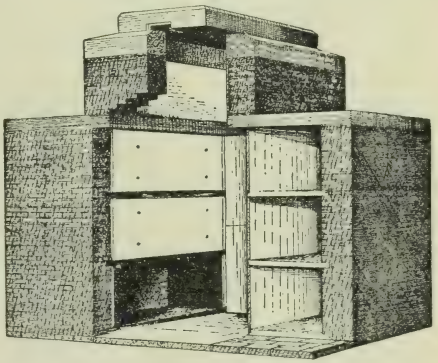
Lot vaults, however, are more common than the single brick graves, as they are suitable for any size lot. The walls are built up to provide for any number of crypts inside and provision is made for floor stones to separate the crypts. In some vaults there are as many as eight crypts. Above the vault proper is built the shaft, commonly of concrete reinforced by 1-inch round O bars of steel and expanded metal buried in the concrete. These walls may support a monument or may be covered below ground level by a stone and then covered with a depth of earth sufficient to support a lawn or any foliage and shrubbery desired.

One of the best features of this form of tomb is that the elements can in no way injure it. The plain heavy slabs especially adapted to it, are durable and in good taste, while they do not obstruct the landscape view.



Exterior View of Underground Tomb.

Entrance is secured through the top, which is often made of heavy glass. A portable stairway can be let down, and



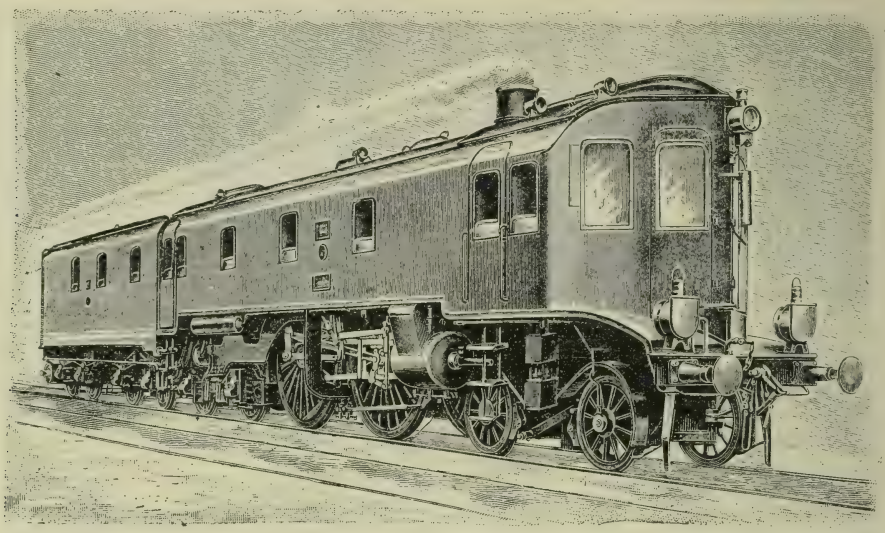
Underground Vault with Six Crypts and a Tomb.

taken out when the place is again closed.

It is impossible for any destructive agency to reach the interior of the strong vault, and those who mourn are haunted by no harrowing thoughts. So far as burial places are concerned the world is progressing backwards. The Egyptians knew more about the care of the body after death than do we with all our twentieth-century enlightenment and progress.

NEW GERMAN LOCOMOTIVE ATTAINS A HIGH SPEED.

A new type of locomotive for express purposes is being tested in Germany. The locomotive and tender are entirely cased in a metal sheathing which is keel-shaped in front to give the least air resistance possible, and in this one point it is expected that from 250 to 300 horsepower will be saved.



New Type of German Locomotive Has Engineer's Cab in Front—Attains High Speed.

The engine-driver's place is in a cab situated in the front of the pointed part of the engine. There is also in the cab a second or assistant driver, who also assists the stoker in his work. For running the engine backwards, which is found necessary in railway stations, the assistant-driver looks after the brake and whistle at the back of the tender. From here and also from the stoker's place, verbal messages can be sent to the driver's cab. In order to facilitate communications on the engines, there are passages on the right and left within the steel sheathing. At the back of the tender there is the usual passage to the train, so that it is possible to keep up communication throughout the whole length of the train, from the engine-driver in the front part to the guard at the end.

All the wheels of the tenders and locomotive are provided with air brakes, which exceed in power any other in use. The length of the locomotive alone is 38 feet. Its weight fully equipped is 94 tons, and the weight of the tender 64 tons. The tender carries 7 tons of coal. The locomotive is constructed for a speed of 80 miles an hour.

HOW TO TIGHTEN UP A SNARE DRUM.

The snare drum gets its name from the four or six small twisted rawhide cords stretched across the lower drum head. When the top head is struck these cords or snares snap sharply against the lower head and greatly increase the resonance of the drum.

It is interesting to watch a drummer tighten up the snare drum heads so as to produce an even tension of the parchments, says Railway and Locomotive Engineering. He first grasps the two press hoops with clamps united by steel rods with a small thumb nut on top of each. These clamps are placed at intervals all around the drum.

Let us suppose that a clock dial plate represents the drum head and the figures on the dial indicate the position of the clamps. The order of tightening the clamps would be much as follows: First the XII, IV and VIII, then X, II and VI and lastly XI, III and VII. Thus an even tension is obtained and the drum gives a sharper and better tone.

The great Simplon tunnel under the Alps and 12½ miles long is completed. It was begun in 1898.

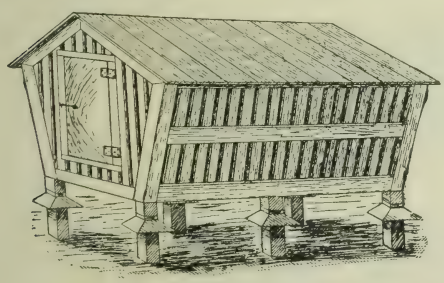
100,000 RUSSIAN SOLDIERS WILL WEAR BULLET-PROOF GARMENTS.

The Russian government has ordered from the company, established at Milan to manufacture the Bendetti cuirass, 100,000 of these breast-plates, which are destined for the armies in Manchuria. Last winter the inventor carried out some tests at St. Petersburg before the czar and high military officials, and it is claimed that the plate is proof against all small-arm projectiles. The cuirass to be supplied the Russian soldiers is flexible, weighs only 17 ounces, is less than half an inch in thickness, and entirely covers the chest and abdomen of the wearer. The United Service Gazette says: "The breast-plates were to be delivered at the Russian consulate at Milan on August 15, the sum to be paid for them being slightly in excess of half a million roubles. The factory in Milan employs 250 workmen, and the process is kept a profound secret."

HOW TO BUILD A RAT-PROOF CORN CRIB.

A corn crib which is cheaply and easily constructed is shown in the illustration herewith. The main feature of the crib is that it is rat-proof. It is constructed of inch lumber; open for air to reach the corn and with flaring sides for protection against rain.

The crib is set on either wooden posts or brick foundations, says the Indiana Farmer. The posts are set into the ground 15 inches and extend two feet above it, where the crib sills rest upon them. About 16 inches



Rats Cannot Climb These Posts.

above the ground are fastened galvanized iron hoods, projecting out and downward around the foundation posts 4 inches in width. Rats could not possibly climb past these. It is quite practicable to shape the hoods out of pieces of tin and nail them to the posts instead of buying the iron hoods.

LIVED IN THE WATER FIFTEEN DAYS.

A life suit in which the wearer can lie down or stand up with equal ease while in the water, is a valuable invention lately given to the world by M. Joseph Probst, a Swiss inventor at Geneva.

The suit is made of India rubber. It opens in the center and can be quickly and easily donned by the most excitable person.

M. Joseph Probst in His Wonderful Life Suit.

When attired in it the wearer is absolutely safe while in the water and it is possible for him to exist there several days. Air-tight compartments arranged on the outside, carry the necessary supplies for a prolonged stay in the water, and the apparatus includes an instrument for scaring away dangerous fish, says the American Inventor. Nearly one-half of the suit is above water at all times. As a test of his invention Mr. Probst remained in Lake Geneva 15 days and nights.

AUSTRALIANS PAY POSTAGE INTO SLOT MACHINES.

A new postal convenience is in use in Australia which would be highly appreciated in this country. It is a slot machine, in which, if no stamp can be procured, the letter and the penny postage are deposited, the words "one penny paid" being stamped on the envelope when the box is opened by the postoffice authorities.

LARGEST WIRELESS TELEGRAPHY STATION COMPLETED.

The largest wireless telegraphy station in the world was completed in September at Pisa, Italy. The buildings are entirely of stone. The machinery and apparatus are being placed as rapidly as possible and by the first of 1905 the station will be ready for receiving and transmitting messages. Wireless telegraphic communication will be established with England, Holland, the United States and Canada and with vessels in the Mediterranean, the Red sea, the Baltic sea and the Atlantic and Indian oceans. On the coast of Montenegro two Marconi stations are in complete working order and are used daily.

SOME PHOTOGRAPHIC CONTRASTS.

Never take a view with the sun directly behind you, says a correspondent of the Photographic News, and reference to Figs. 1 and 2 herewith given will show the worth

Fig. 1.

Fig. 2.

of the advice. Fig. 1 shows the result with the sun behind the photographer; the shape of the objects, shadows, and even perspective are lost. Fig. 2 shows the effect with the light coming from the side, and how great an improvement!

Another error to be guarded against is lack of foreground. Note the contrast between Fig. 3 and Fig. 4. In the former the object has been to get as much of the tree as possible, and consequently foreground has been sacrificed, and the tree looks as though it were anchored in the air, rather than firmly rooted in the earth. In Fig. 4 the top of the tree has been sacrificed to gain more foreground and the top-heavy and unsymmetrical effect thus eliminated.

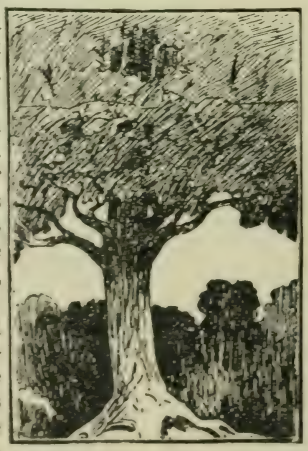


Fig. 3.

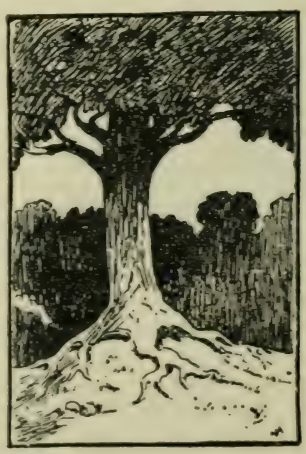


Fig. 4.

HOW TO MAKE REVERSED PRINTS DIRECT FROM THE NEGATIVE.

A straight print from a reversed negative may be made after the following method with as good results as if made in the regular way:

Fix an ordinary lens, the one used in making the negative will do, in the end of a packing box and lay the printing frame in the other end of the box with the glass side of the negative next to the paper inside that end. The lens end of the box should be turned to the sky or the light.

The rays of light must be so nearly parallel that they will print through the glass without perceptible blur, and the disc of light made by the lens should completely surround the frame.. The larger the disc the longer should be the exposure.

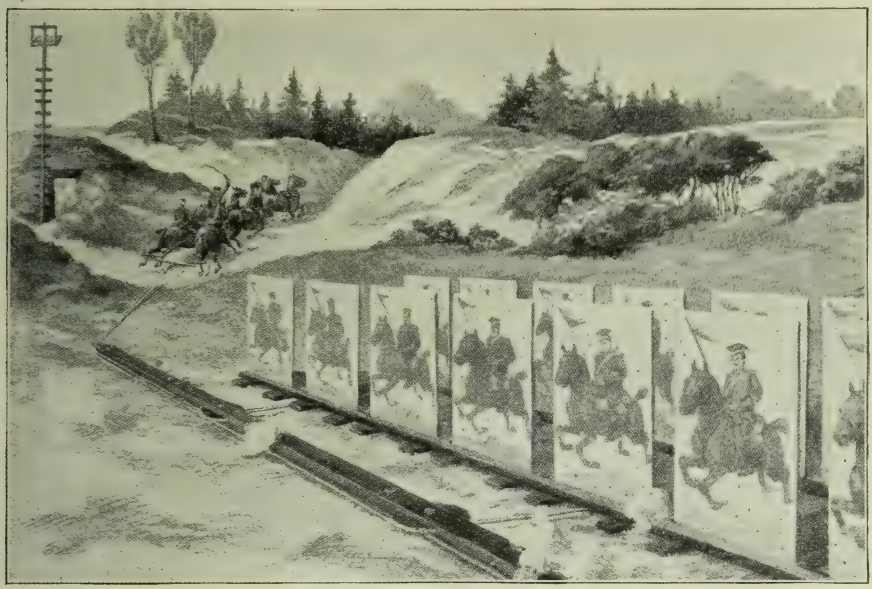
HOW TO MAKE HECTOGRAPH SHEETS.

Some people prefer hectograph sheets to the regular tablet, because the sheets are made on blotting paper and clean by standing, whereas the gelatinous tablet must be washed off when through using it or it will not make a clear print next time.

To make hectograph sheets soak 4 parts of glue in 5 parts of water and 3 parts of ammonia until it is soft. Heat it and add 3 parts of sugar and 8 parts of glycerine. Apply the mixture to blotting paper, saturating the paper and adding successive coats until one side has a smooth surface. Use the smooth side for reproducing the writing just as the tablet is used, excepting sponging them off.

Any number of these hectograph sheets may be made at a time and kept for future use.

Realistic Target Practice in the German Army



Life-Sized Pictorial Cavalry Used in Target Practice in the German Army

The German army has adopted a method of target practice in which a life-sized body of charging cavalry are fired upon by a force of riflemen, the cavalry advancing at full gallop, or the same rate as in an actual conflict. This novel target was adopted in order to test the number of telling shots made by the riflemen under those conditions.

The life-sized figures of the cavalry are painted upon a movable screen which is connected by strong ropes to an immense beam. These ropes pass over pulleys in the beam and thence along the beam, and to their ends is hitched a team of horses. These horses are set at full gallop and the pictorial cavalry charge toward the beam, while the infantry fire.

How to Pasteurize Milk

Milk can be successfully pasteurized in even a small way without the use of expensive machinery. Hoard's Dairyman gives the following directions:

Obtain a tank large enough to hold four or more deep setting pails about 8 inches in diameter and 20 inches deep. Have water and drainage pipes so arranged that the tank can be quickly filled and emptied. Fill the tank with sufficient hot water so that it will come above the milk in the cans. Set the cans of milk in the hot water and turn on enough steam from a small boiler to heat the water to about 160° F. Heat the milk in the cans with constant stirring, as rapidly as possible to 140° F. and hold at that point for 20 minutes.

Draw off the hot water and let a constant supply of cold water flow into the tank, stirring the milk in the meantime so that it may cool as rapidly as possible. It should be cooled to 50° F. or below. It will take some skill and experience to do the above successfully, as well as considerable work.

It should be understood that pasteurizing milk does not increase the purity, but only kills the bacteria that are present. If clean milk is desired, it must be obtained by methods of cleanliness in the stable.

LOCOMOTIVE HAULED ITSELF 300 MILES BY WATER.

Queerest Craft Ever Seen on the Ohio River Sailed From the Resolute Town of Pittsburg

"Always has been a lot of 'git-up-and-do' around about the town of Pittsburg," said an oldtimer who had divided his life serving on the Ohio river steamers and railroading. "It was about 35 years ago that this 'do-it-anyhow' disposition of Pittsburg added to the 'we-always-deliver-the-goods' fame of an early locomotive building firm, brought about the queerest looking craft that ever floated on the waters of the strenuous Ohio river. The firm was known as Smith & Porter. One J. Y. Smith was superintendent at that time. There was a railroad just 12 miles long running south out of Greenupsburg, Ky. This road had to have a locomotive built in quick time, and it contracted with Smith & Porter to build it. The locomotive had to be delivered by a certain day, or according to the agreement the contract was void. So the locomotive firm put extra men to work, and the locomotive was completed, tested and ready for shipment so as to reach its destination on the contracted date. But here's where the 'get-there-some-old-way' character of Pittsburg had to come in. It happened that the Ohio went down so rapidly at the time that on the day the locomotive was ready for shipment every towboat on the river was tied up, and not a craft of any kind was running. There were not any railroads running from Pittsburg to Greenupsburg, nor anywhere near there. No trains and no boats, with Greenupsburg 333 miles away, and the engine had to be delivered there in three days. What could be done?

" 'Find a way or make it,' said that Superintendent Smith, when his foreman said there was no way of delivering the engine. Then what did that superintendent and foreman do? They simply went to work and built a 'locomotive-steamboat,' the queerest looking craft, as I said before, that the Ohio ever kept above water. The very locomotive that was to be delivered to the railroad was made to furnish the motive power for propelling the craft. The locomotive was made to haul itself to Greenupsburg by water.

"Smith and his assistants secured a flatboat. Engineer James M. Schooley helped him fix the locomotive in place. After the engine was properly lined up on the hull the side rods were disconnected and each coupled up to a temporary crankshaft placed across the boat, and each driving a paddle wheel.

"A supply of coal was placed on board, the engine fired up, and with the steam gauge indicating 120 pounds pressure Engineer Schooley opened the throttle.

"Steam rushed to the cylinders, the paddle-wheels began to revolve, and under the skillful guidance of the man at the wheel the locomotive headed for midstream. This is the only time on record that a locomotive navigated the Ohio river. The locomotive made the trip successfully and delivered itself to the railroad on contract time."

PURE AIR AND NO DRAFTS FOR STREET CARS.

A most effectual blow against pneumonia and the germ diseases has just been struck by the chief of the Brooklyn health department, and consists of a very simple method of ventilating street cars. In the deck-sash of the car he had two openings made about 10 inches apart and into these openings were fitted slats which deflect the intake of air to the roof of the car. From the side of the car between these openings was extended a shingle against which the wind strikes when the car is in motion. The whole scheme of ventilation then depends on the motion of the car at the average rate of 15 to 18 miles an hour. The air strikes the front of the shingle and is deflected into the car, while any dust or cinders it may carry fall from the shingle to the ground. At the same time the forward motion creates a vacuum in the rear which sucks out the impure air in the car through the rear slats. The cold pure air entering the car goes downward while the warmer impure air rises and passes out. In this manner 300 cubic feet of pure air enters the car at the front each minute and in the same length of time the same amount of impure air is exhausted from the rear.

In tests the atmosphere in a car was rendered unbearable and the car then set in motion and in two minutes and thirty seconds was absolutely pure, while a lighted taper did not show the motion of the air within the car. The street cars in our great cities, overcrowded and poorly ventilated, are the breeding places of disease.

Popular Mechanics five years only three dollars.

TALKS WITH INVENTORS.

A recent decision of the Commissioner of Patents emphasizes the importance in an inventor filing his application for patent. The case decided was between two parties, each of whom claimed to have invented the same machine for making pool balls. One of the parties, Matthes by name, proved that he invented the machine in June, 1898, and that he made a few pool balls on said machine at that time. The other party, Burt, proved that he invented the machine in December, 1899. Burt applied for a patent in April, 1901, and at once began the manufacture of pool balls on his machine. Matthes learned in December, 1901, that Burt was making pool balls on a machine exactly like the one that he, Matthes, invented in June, 1899, and he at once, or in February, 1902, applied for a patent before a patent had been granted to Burt.

The Commissioner decided that notwithstanding Matthes was the first inventor, that he did nothing until he learned that Burt, his competitor, was using the invention, and that by his silence and failure to apply for a patent he is presumed to have abandoned the invention, and that Burt, who was a bona fide independent inventor, even though he came after Matthes, was diligent and had done all that the law expected of him, and therefore should receive the patent. The Commissioner, after quoting several decisions of the United States Court of Appeals on cases where similar conditions prevail, says: "From the aforegoing cases we may extract the principle that an inventor who has completed the inventive act by the reduction of his invention to practice may lose his right to obtain a patent, in favor of a subsequent inventor, by concealment and delay in applying for a patent." The term "reduction in practice" means either the making and placing on the market of the invention, or the public use of it, or the filing of an application for a patent.

Many inventors lose their inventions by procrastination in applying for a patent or in placing the invention before the public. They wait until others have gone ahead and done these things and then try to come in at the eleventh hour and prove that the invention is theirs. As seen from the above decision, the inventor who does this runs the risk of losing everything.

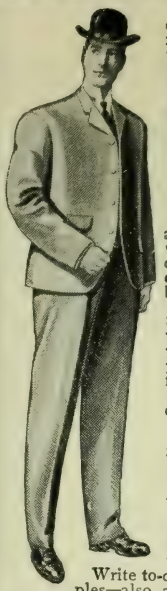
STILL, HE TIPPLES A LITTLE.

Give John Bull a chance. He is not perhaps the abstemious man he might be, but he certainly is not, as you say, the "champion guzzler" of the world. He is not even in the running for the title, as the following figures prove: Where the average Belgian drinks 710 glasses of beer in a year, the Briton is content with a shade over 500; for every glass of wine drunk in the United Kingdom, France drinks 56, and the Dane drinks seven glasses of spirits for every one the average son of John Bull consumes. Among all the nations of Europe John takes second place as a beer-drinker, eighth as a consumer of wine, and tenth as a lover of spirits.—London Tit-Bits.

REPLACED A SCALP.

A few weeks ago a girl in New York had her scalp torn from her head in an automobile accident. After the girl had been taken to the hospital the scalp was picked up in the road by a policeman and sent to the hospital where it was replaced on the young lady's head. Strange to relate, the remarkable operation is proving wholly successful. The cuticle has begun to unite and the hair shows signs of vitality and attending physicians have announced that a healthy glow is now apparent in the scalp.

DO YOU WANT TO DRESS STYLISHLY



Do you want an **all-wool** suit or overcoat **made for you,** and **to fit you,** from the newest fashionable fabrics? Do you want to be **absolutely satisfied** before you pay for the garments? Do you want a pair of **all-wool,** stylishly made

$5 TROUSERS FREE

of cost to you for doing us a favor? Then **read carefully** and **act promptly** on this

Special Offer:

We will send you samples of all-wool Clay Worsteds, Thibets, Serges and Cassimeres, in black, blue, brown and fancy mixtures, from which we will make you a suit or overcoat for $10.00, **the equal of which you cannot buy for $15 anwhere else,** and give you an extra pair of $5.00 All-Wool Trousers **without charge,** providing you will hand ten sets of samples (which we furnish you free), to ten men who will be likely to buy suits on our **exceedingly liberal terms.**

Don't take our word for it. Just give us the opportunity to **prove** that we can and will **save you money** and **give you absolute satisfaction.** You take no risk. We make your suit, send it to you and give you ten days time to **actually wear the garments** to prove their positive worth. That's fair, isn't it?

Write to-day for our New All-Wool $10 Suit Samples—also ask for our Superb special prices—our New Imported All-Wool Fall Fabrics at $12.50, $15.00 and $18.00 Fall Style Book and Complete Instructions for taking measures, **all sent free,** together with our Presidential Proposition, that **pays you $2.50 in cash before you get your suit.**

OWEN T. MOSES & CO., 212 MOSES BLDG., CHICAGO

References: Your friends, or Milwaukee Ave. State Bank, Chicago. Capital $250,000.

Show Your Colors

PATENT APPLIED FOR

BOY OR MAN

Encourage your party by showing which "side of the fence" you are on.

Our Campaign Novelties

are unique, attractive and artistic. **Roosevelt and Fairbanks Eyeglass Pins** [see cut above] gold plated. **Sample Price 25c.,** postpaid. Same for **Parker and Davis.**

Campaign Fob. Handsomely nickeled — lettering enameled in three colors, russet leather strap and nickeled buckle; for both candidates. Sample price 25c., postpaid. Special quantity prices to agents.

Both These Are Great Sellers.

Write for samples today.

Cash Must Accompany Order.

CHICAGO COMMERCIAL AND SPECIALTY CO.,

528 W. 63rd ST., DEPT. A., CHICAGO, ILLINOIS

YOU CANNOT "MAKE BRICKS WITHOUT STRAW" BUT YOU CAN SECURE ANY OF THESE

High Grade Tools Without Money

The following carefully selected list of tools includes those which every mechanic needs, and which everyone who engages in mechanical work as a recreation will greatly desire to possess. We have selected a well-known brand, the excellence of which for quality and accuracy is beyond criticism. They are all from the celebrated works of the L. S. Starrett Company, manufacturers of fine mechanical tools. Every tool in these lists can be easily earned by securing a small club of new yearly subscribers to Popular Mechanics;

ANY TOOL IN THIS LIST FOR ONE NEW SUBSCRIBER

		Retail Price.
No. 303	4-in. Spring Tempered Rule	$ .45
No. 403	4-in. Beveled Edge Rule	.45
No. 330	4-in. Narrow Hook Rule	.45
No. 391	Spring Tempered Center Gage	.45
No. 450	Folding Pocket Rule in case	.50
No. 135	Nickel Plated Pocket Level	.50

ANY TOOL IN THIS LIST FOR TWO NEW SUBSCRIBERS

No. 303	Spring Tempered Rule, 9-in	1.00
No. 403	Beveled Edge Rule, 9 in	1.00
No. 420	Hook Rule, 6 in	1.00
No. 21	Thin Straight Try Square, 2 in.	1.00
No. 125	Adjustable Caliper Gage, 2½-in	1.00
No. 193	Protractor	1.00
No. 40	Screw Pitch Gage	1.00
No. 172	Thickness Gage	1.00
No. 87	Mercury Plumb Bob	1.00
No. 146	Adjustable Hack Saw Frame and Blade	1.00
No. 104	Speed Indicator	1.00
One Dozen	No. 116 Asst. Nail Sets, in case	1.15

ANY TOOL IN THIS LIST FOR THREE NAMES EACH

ANY TOOL IN LIST 1 AND LIST 2, OR,

No. 405	Patent Draftsman's Scale, 12 in	$1.50
No. 380	Steel Straight Edge, 18 in	1.80
No. 11	12-in. Combination Square	2.00
No. 60	6-in. Reliable Try Square	1.25
No. 425	Slide Caliper Rule, 3 in	2.00
No. 15	3-in. Universal Bevel	1.50
No. 6	Screw Pitch Gage	1.50
No. 36 or 37	6-in. Lock Joint Transfer Calipers	1.50
No. 186	Drill and Steel Wire Gage	1.50
No. 132	6-in. Level	1.50

TOOLS IN THIS LIST FOR FIVE NAMES EACH

ANY TOOL IN LIST 2 AND LIST 3, OR

No. 380	24-in. Straight Edge	$2.40
No. 510	Steel Tape in Leather Case, 50 in	4.00
No. 9	12-in. Combination Square Set	4.00
No. 33	Hardened Steel Combination Squares, Drop Forged	3.00
No. 20	4½-in. Hardened Edge Solid Steel Square	3.50
No. 25	4-in. Caliper Square with Adjustable Screw	4.00
No. 66	Locomotive Guide Liner	3.00
No. 57	New Universal Surface Gage, 12 in	3.00
No. 97	12-in. Improved Level for Testing Shafting	2.50
No. 197	12-in. Electrician's Level Non-Magnetic	3.50
No. 163	24-in. Draughtsmen's T. Square	3.50

TOOLS IN THIS LIST FOR TEN NAMES EACH

ANY TOOL IN LIST 1 AND LIST 5, OR,

No. 3	1-in. Micrometer in Case	$6.50
No. 113	1-in. Micrometer in Case	7.50
No. 2	2-in. Micrometer in Case	7.25
No. 124	B. Inside Micrometer	6.25
No. 360	Universal Bevel Protractor	5.75
No. 196	Universal Dial Test Indicator with Tool Post	7.50

Any tool in the Starrett Catalog desired, and not given above, will be given as a premium for a club. ∴ ∴ For particulars address

POPULAR MECHANICS : : Journal Building : : CHICAGO

CO-OPERATION

is the mystic key to fortune, fame and happiness. We hold the **key**, but cannot turn it alone. We will share with **you** in the greatest **money-making** co-operative business on earth. We are **giving away 250,000 shares** of Treasury stock. Par value $1.00 per share. Not a share can be bought for cash.

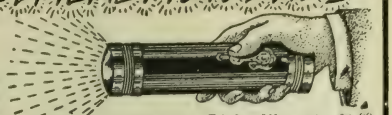
There's 20 Shares for You

No more for anyone. **We don't want your money,** don't send us a cent, just a postal card. Our plan is **unlike** that of the trusts who give millions of shares to drones, called "promoters." We are giving ours to **partners**—energetic men and women. This stock will pay large dividends and costs you—just a **little** effort—**that is all**—fortune's knock is at **your** door, believe it or not, as you please.

THE PEOPLE'S COMPANY

144 West Madison Street, Chicago

Electrical Novelties



Our Free Catalogue describes many other electrical novelties. We promptly refund money if dissatisfied.

Agents Wanted These novelties sell on sight and are easily shown. Everybody is interested. We want good, live agents in every place, big or small. All particulars for a postal. Write today.

Pocket Elect. Light (like cut)	$1.00
Telephones, complete	$2.50 to $5.95
Door-Bell Outfit, complete	1.00
Telegraph Outfits	2.00
Home Medical Batteries	1.00 to 6.50
Battery Motors	75c. to 12.00
Bicycle Electric Lamps	3.50
Electric Hall and Porch Lamps	3.00
Electrical Carriage Lamps	5.00
Water Motor and Dynamo	10.00
1-2 h. p. direct current motor	26.00
Miniature Electric Railways	3.25
Electric Scarf Pin	1.50

J. W. SCRIBNER & CO., 197 Niagara St., Tonawanda, N. Y.

THE OLD FASHIONED WASHBOARD

By John J. Hurley.

How dear to my heart is the old-fashioned washboard
That mother used washing when I was a boy,
With its zinc-covered ridges the suds used to play in,
And soap bubbles gamboled to my childish joy.
Ofttimes have I watched her when wearing her knuckles,
As over the ridges our duds she would rub,
I ne'er will forget how she splashed and she slathered
The old-fashioned washboard that stood in the tub.

(Chorus)

The old-fashioned washboard;
The zinc-covered washboard;
The back-breaking washboard that stood in the tub.

I'll always remember when school it was over,
And home I returned I never could pass
Unless I jumped over the white sheets and napkins
That mother had spread out to bleach on the grass.
And poor mother lay on the old-fashioned sofa,
All played out, and I'd have to eat just cold grub,
She never had hot lunch for me when she tackled
The old-fashioned washboard that stood in the tub.

(Chorus)

Some folks always kick about up-to-date laundries,
And say that they wear out their clothes every day;
But give them to me, so I'll have a hot dinner
At home, and the smell of the soap-suds away.
I know that the washing machine is much easier
On all of our clothes than to take them and rub
Till the buttons and bosoms are lost and worn out
By the old-fashioned washboard that stood in the tub.

WILL GIVE FARMS TO EMPLOYES.

The Pennsylvania Railroad contemplates parceling out to its employes hundreds of acres of its desirable lands along railway routes, each of the employes thereby becoming proprietor of a small farm. In France 15,000 railway employes have free use of such farms and the plan is considered a great success.

HOW CONGRESSMEN TOIL.

If comfort and convenience are highly conducive to the production of good laws and to able management of the ship of state, it seems that legislators in the United States Capitol should lead the world in the latter particulars.

But the congressman, so well fixed, is not satisfied—he desires more room. So a large amount of money will be spent for a congressional office building, where his clerk can attend to correspondence, ship seed, literature, etc., and where constituents and others can be seen. The new building, to be begun this summer, will be a handsome stone structure, containing several hundred rooms, located near the southeastern corner of the Capitol grounds, fronting on New Jersey avenue and B street.

When the lawmaker takes his seat at his handsome desk ready for the business of the session, if he so chooses he can sit there all day without saying a word (though silence is not considered "golden" in the House), except when voting. If the M. C. desires anything while in his seat he does not, as was once the custom, clap his hands for a House page; it is only necessary to touch a button. An independent call apparatus is located in each corner of the Hall. The device is placed on a small table and consists of an exposed series of numbered platinum disks. Each device takes care of 200 desks. The desks on the Democratic side of the House range in numbers from 1 to 200; those on the Republican side from 201 to 400. At the right-hand side of each desk and attached to the bottom is an electric push button. Pressing this the circuit is closed and a current flows to the registering device corresponding to the number of the desk button. The disk appears red-brown, and after about 30 seconds resumes its normal color. The operation is entirely without noise, and the person in charge of a call station sends a page to the number registered.

A $200,000 tomb awaits a man living at Riverdale-on-Hudson in a barn on an estate he once owned. It, of course, makes little difference how he must live now, he is sure to have a decent burial. However, it may be some one's opportunity to get a magnificent tomb at something less than cost.

Jacobs (the swell): "Goot morning, Isaac. Vill you have a cigar?"

Isaac (astonished): "Vhy, Jacobs, vat is the matter vid it?"

SAVE MONEY BY MAKING YOUR OWN BOILER COMPOUND. We furnish formulae for effective and economical **Boiler Compounds** based on an Analysis of your feed water.

THE ELLSWORTH LABORATORIES

SLIMMER & STILWELL, Ana'ytical Chemists 357 DEARBORN ST., CHICAGO

CARBURETTOR TROUBLES CURED

The Landgraf Carburettor will make your engine go if there is any go in it. We guarantee it.

FURNISHED FOR MOTOR CYCLES, AUTOMOBILES, STATIONARY ENGINES and LAUNCHES

Crank Hangers for motorcycle builders; special, wide bracket with lugs for drop frame to take large motor. Crank hangers to fit any make and style of bicycle. SPROCKET MILLING AND MACHINE WORK.

Every motorcycle builder should get our circulars on carburettors and motorcycle hangers, and every bicycle shop should use our repair hanger. Write us for prices and trade discounts.

THE A. & J. MANUFACTURING CO., - 17 South Canal St., Chicago

The American Well Wks.

AURORA, ILL., U. S. A.

CHICAGO, ILL. DALLAS, TEX

For over a quarter of a century have been building WELL SINKING and PROSPECTING MACHINERY and TOOLS for ROCK and ALLUVIAL, ROTARY and CORING WORK of moderate cost, speedy economical in operation, enabling large per cent saving in pay roll and pipe bills.

This photograph may not illustrate the style of machine best suited to your work, but we have one hundred other styles and sizes some of which will. Why should we not have your orders?

We have pleased old customers, can please new ones.

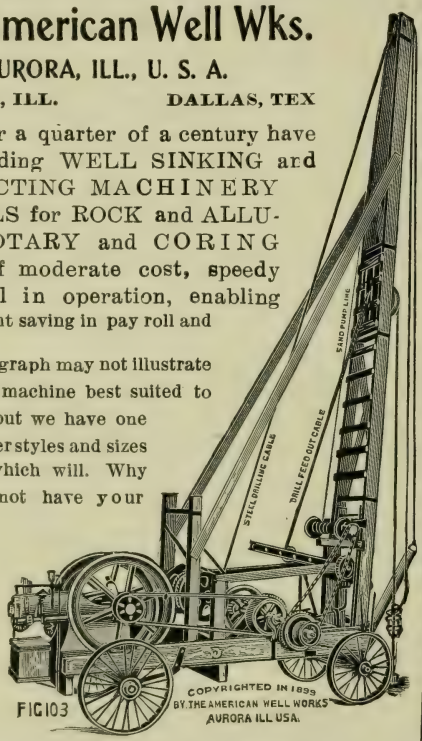


FIG 103

WHERE HAY FIELD BEATS GOLD MINE.

Hay clears a profit of 100 per cent in the Yukon valley, while gold—well, gold is all right if one is fortunate enough to get hold of it, but the chances are a good hay crop will pan out better than gold prospects.

A Dawson freighter at Gravel Lake, on the trail between Dawson and the Duncan district, Stewart river, put in an immense quantity of fine hay last fall. Last winter he baled 600 tons of hay for which he received $140 per ton, or $84,000 for the entire crop. The entire crop was cut by scythes and handled in the old-fashioned way. A crew of ten men and two 6-mule teams collected the bales and carried them to market. Next year the Alaskan farmer proposes to use the most modern of farm implements.

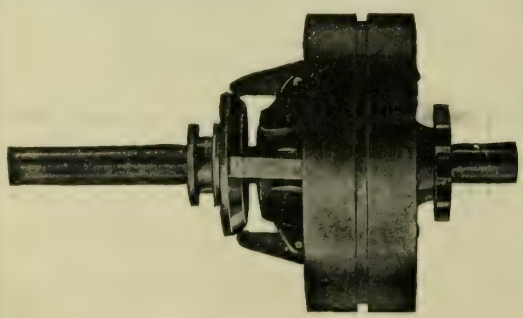
BLACK PAPER RESTS THE EYES.

Will the time come when all our books, magazines, newspapers and current literature of any kind will be printed in white letters on black paper?

Prominent medical authorities have discussed the point several times, claiming that the black paper rests the eyes, where the glare of the white paper tires and even injures them.

Recently the subject has again been brought to notice by Dr. Arthur Fisher, of Montreal, before the Hahnemann Society, and was favorably commented on.

Technical difficulties have prevented even a fair trial of the remedy for weak eyes hitherto, and there are other objections and weak points, but should the change ever take place it will be revolutionary in its effects.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

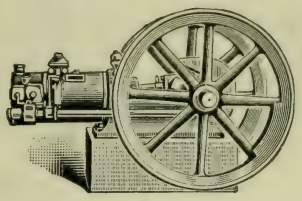
Successors to THE P. J. DASEY CO.

339 Michigan Blvd. Chicago, Ill., U. S. A.

The Marked Superiority of the

"OTTO" GAS AND GASOLINE ENGINES

In ease of starting and smoothness of running is readily apparent when compared, side by side with the cheaper kind.



While "comparisons are odious," they are sometimes helpful in arriving at the truth. See our exhibit at the World's Fair, Block No. 41, Machinery Hall, and draw your own conclusions.

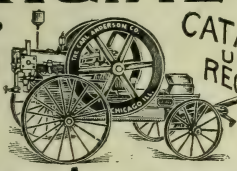
The OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn St. MINNEAPOLIS: 318 3d St. OMAHA: 1108 Farnam St.

ASK FOR CATALOG F.

THE "GUS" GAS AND GASOLINE ENGINES

NONE BETTER MADE



CATALOG UPON REQUEST

THE CARL ANDERSON CO.

23-27 N. CLINTON ST. CHICAGO

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

Fire It Right Back

AT OUR EXPENSE

That's what you want to do if you can find any fault with our new Dust Proof 2¾ H. P. Engine. We are making a Specialty of this one size Gasoline Engine and build nothing else.

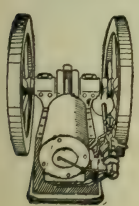
They are designed right to start with, and then built so they will last even under severe service. Our price is $138.00, complete and ready to run when delivered.

Get Our "Money Back" Offer

McNAUGHTON-BASSETT CO. Charlotte, Mich.

CRANE FITTINGS

ESTABLISHED 1855



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY

25 West Randolph Street, Chicago

NEW AND SECOND-HAND ELECTRICAL **MACHINERY**

COMPLETE PLANTS INSTALLED.

Expert Electrical Repairers of Armatures, Fields and Commutators.

ILLINOIS ELECTRICAL MFG. CO.

1222 S. Adams St. : : : Peoria, Illinois

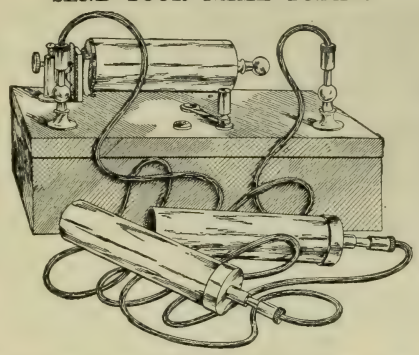
ELECTRICITY

BOOK FREE

Profusely Illustrated From Life, Shows How and Why Electricity Cures and Prevents Sickness.

SEND YOUR NAME TODAY.

Our No. 4, Only $1.95



Express Prepaid

Why not find out what electricity will do for you? Write today for our new Free Book—**"Cure Yourself By Electricity"**—illustrated with photos from life. Shows how the New Home Batteries cure **Rheumatism, Neuralgia, Lumbago, Headache, Insomnia, Constipation** and all **nerve** affections and diseases arising from **sluggish circulation**; also how they afford **electric baths** and **beauty massage** without cost at home. We send our batteries **Prepaid on Approval** without a cent in advance (prices $1.95 and up) and allow **10 Days Free Trial. Write For Our Book.**

Detroit Medical Battery Co.,
1039 Walker Block, Detroit, Mich.

STEVENS

A Day in the Woods

with a trusty FIREARM as a companion is both enjoyable and beneficial to the health. **NOW** is the time to feel the thrill of the great "out-of-doors." Your happiness will be complete if equipped with a "STEVENS."

We manufacture an extensive and varied line of

RIFLES, PISTOLS, SHOTGUNS

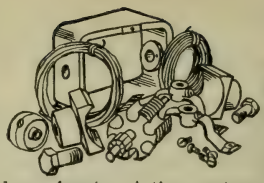
suitable for young and old of either sex

Your dealer handles STEVENS ARMS. Where not sold by Retailers we ship direct, EXPRESS PREPAID, upon receipt of catalog price

Send 4c. in stamps to cover postage on 136-page illustrated STEVENS book, with cover design by A. B. Frost. A manual of ready reference indispensable to all who shoot or are going to

HIT THE MARK with our RIFLE PUZZLE! This clever novelty will be mailed FREE anywhere upon request.

J. STEVENS ARMS & TOOL CO.
40 Main St.,
Chicopee Falls, Mass., U. S. A.



YOUNG MEN why don't you build your dynamo motor or water power plant? Our finished parts are modern, up-to-date and complete. No tools or machine shop needed to make a successful machine. They furnish an opportunity to wind a dynamo and try your own work at a less expense than any other known method. Indorsed by all electrical students. Sizes 25-50-75 watt 1-4 and 1-2 h. p. Catalogue, 4 cents. Active agents wanted.

C. S. Piper & Co., 4352 Cottage Grove Ave., Chicago.

IMPORTED IMITATION

DEDION SPARK PLUGS JUST NOW - - - 40 cent each

THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago, Ill.

STRANGE TREES OF STRANGE CLIMES.

On the Canary islands grows a fountain tree, a tree most needed in some parts of the island. It is said that the leaves constantly distill a quantity of water that is sufficient to furnish drink to every living creature in Hiero, nature having provided this remedy for the drouth of the island. Every morning near this part of the island a cloud of mist arises from the sea, which the winds force against the steep cliff on which this tree grows, and it is from the mist that the tree distills the water.

China, too, claims her remarkable tree. This is known as the tallow tree, so called from the fact of it producing a substance like tallow, and which serves the same purpose, is of the same consistency, color and smell. On the island of Lewchew grows a tree about the size of a common cherry tree, which possesses the peculiarity of changing the color of its blossoms. At one time the flower assumes the tint of the lily, and again shortly takes the color of the rose.

In Tibet there is a most curious tree known as the tree of the thousand images. Its leaves are covered with well defined characters of the Tibetan alphabet. It is of great age, and the only one of its kind known there.—N. Y. Herald.

TURBINE VESSEL FOR LAKE MICHIGAN.

Next summer between Chicago and Michigan resorts one of the finest vessels on fresh water anywhere, will ply the waters of Lake Michigan. The craft will be called the "Turbine Queen," and will be built this winter at a cost of $300,000.

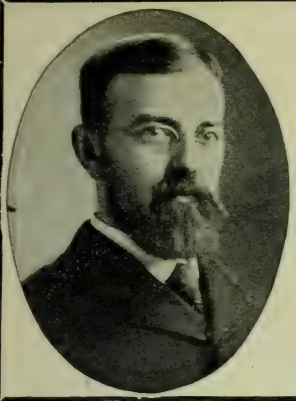
IT HELPS BUSINESS

To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs

Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.
174 Wabash Ave., - - Chicago



Young Man Make Money On The Side

No Experience Required
Sample Outfit Free
They cost us $25.00
Suits cost agents from $10.00 to $20.00
Agents make 33⅓ per cent or 50 per cent.

Biggest Agent has sold $5,000 since March 1, previous to which he never had a tape in his hands.

ALL GARMENTS UNION MADE. FALL SAMPLES NOW READY

JAS. F. STILES & CO.
Wholesale Tailors 293 E. Madison St., Chicago

VAST FORESTS IN HAWAII CONTROL THE WATER SUPPLY.

Fifty thousand acres of the Hawaiian forests sprang from a single algaroba tree planted in 1837 by a Catholic priest. To-day that first tree still stands, 50 feet tall and 2 feet in diameter, while near the sea level on all the islands stretch the dense forests of the younger growth, ranging from 50 to 60 feet in height, and springing up in places so arid and rugged and bare that no other growth could obtain a hold, much less flourish.

The forests thus introduced are the most valuable of any the islands produce. For fuel it sells for from $9 to $10 per cord; for fence posts it is in great demand, and when cut down it rapidly renews itself by seeds and sprouts, and a new forest from 20 to 25 feet in height takes the place of the old within four years after cutting. When three years old it bears pods which are an important stock food.

In an interesting bulletin the Bureau of Forestry tells something further of the Hawaiian forests. The native forests are a dense growth on the elevations and are of a tropical character. The lehua forms about three-fourths of the native forests and grows to a height of 30 to 100 feet; the tall ones are 4 feet in diameter with a clear length of 40 to 50 feet. Dense undergrowth forms an impenetrable forest, and this undergrowth holds so much water that a good drink may be squeezed out in a dry season. The lehua has no commercial value save for fuel.

The koa is the one tree valuable for its lumber. It is often 75 feet high and from 6 to 8 feet in diameter. The wood is in rich shades of red and brown and the grain fine and indistinct. Mamane is a tree useful to ranchmen for posts and the kukui produces an oily nut used by natives for illumination.

Stock, insects, grasses, fire and clearing have caused a great decline in these forests. For many years cattle ran wild and their slaughter was prohibited, and though many thousands have since been killed there are thousands left. These menaced the forests. Goats were even more destructive and immense numbers of deer trampled the undergrowth and rubbed the bark from young trees. Injurious insects and rank grasses followed in the wake of the stock and serious fires laid waste vast tracts.

The water supply for the sugar industry depends on these protective native forests. Farming is an unprofitable business there, and the sugar export is 96 per cent of the total exports, and other industries flourish largely because the sugar industry exists. Commercial interests will control the government's management of these forests. Vast reserves will be fenced in, and all that will promote the welfare of the greatest number will be carefully attended to.

Are You a Lover of

Good Tea and Coffee

We are making a Special Proposition to those who enjoy a beverage that is not only delicious, but more appetizing and nutritious than any other tea and coffee on the market.

THE GREAT AMERICAN TEA COMPANY

Write for **Special Christmas Proposition** to persons getting up clubs or sending orders of $5.00 and upwards.

It is worth your while, as we intend to use unheard-of efforts to increase the number of customers during the next two months.
This offer applies only to readers of Popular Mechanics.

Write us at once—to-day—to
MR. CARL,
Great American Tea Co.,
31 & 33 Vesey St., P. O. Box 289, New York

BIG BRASS BAND OFFER.

We sell the celebrated IMPERIAL, DUPONT and MARCEAU Band Instruments at about one-half the prices others ask for the same high grade goods. For our **Free Band Instrument Catalogue**, also our **Free Booklet**, entitled, "How to Buy Band Instruments," for large illustrations and complete descriptions of our three large lines of brass instruments, also everything in Drums, Clarionets, Flutes, Saxophones, etc., etc., for the free catalogues, our guarantee and refund proposition, for the most liberal band instrument offer ever heard of, for the new method of selling instruments fully explained, for something new and immensely interesting to every bandman, cut this ad out and mail to us today. **SEARS, ROEBUCK & CO., CHICAGO.**

BOYS

We are giving away Base-ball outfits, Boxing Gloves, Punching Bags, Footballs, etc.

Send address for full particulars to

POPULAR MECHANICS,
602 Journal Bldg. Chicago, Ill.

Telegraphy

taught thoroughly. Institution established 1874

Endorsed by officials Railroads and W. U. Tel. Co. Positions secured. **Entire cost**, tuition (telegraphy and typewriting, board and room, **6 Mos. course, $89. Can be reduced.** Home nstruction also given. Catalogue W free.

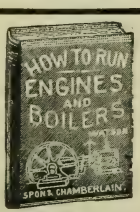
Dodge's Institute of Telegraphy, - - Valparaiso, Ind.

AGENTS Make 100 PER CENT on **Conklin's Vest Pocket Argument Settler.** Revised edition with New Census Statistics, 254 pgs. A complete Encyclopedia of a million proved Facts Tables, and General Information. It settles Arguments instantly. Invaluable to everyone. Sample postpaid, Cloth, **25c.**, Morocco, **50c.** Stamps taken. Agents wanted. **George W. Noble, Lakeside Bldg., Chicago, Ill.**

SAMPLE COPY KANSAS OIL EDITION INVESTOR'S REVIEW **FREE**

Tells all about great opportunities to make money in this new oil field. This special number is fully illustrated and contains a vast fund of valuable, interesting and reliable information; read it before you invest a dollar. Heed its advice and you will surely become a successful investor. There are hundreds of opportunities to make big money in Kansas oil. Get posted and keep posted. Do it now, not to-morrow, BUT RIGHT NOW. ASK FOR KANSAS OIL EDITION, Just Out. Address,

INVESTOR'S REVIEW, 1461 Gaff Building, - - - - CHICAGO, ILLINOIS.



7,000 COPIES SOLD

THE BEST BOOK to HELP YOU MAKE

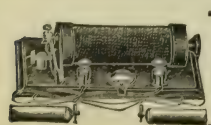
MORE WAGES

Written in plain language and fully illustrated.

Spon & Chamberlan Dept. P. M. Liberty Bldg., New York **FREE for $1.00**

INDUSTRY MAGAZINE for August contains "How I Got My Automobile and Made It Pay for Itself." YOU can do likewise. How to make an Electric Telephone for fifty cents. A Valveless Gasoline Engine for automobile, boat or power, illustrated. A miniature Water Power Electric Plant. Electrical Firecrackers, and many other valuable articles, formulas, hints and helps for Mechanics, Amateurs, Students, Teachers and Business Men. Every number full of helpful PRACTICAL information. How to make Electrical Machinery and Apparatus, Gas and Steam Engines, Boats, Launches, Traps, Camps, etc. We furnish complete working drawings and instructions. Also articles on Mining, Technology, Manufacturing, etc. Fifty cents per year.

Three months' trial, 10 cents. SPECIAL OFFER to new subscribers—For fifty cents, Industry Magazine 17 months and a 64-page illustrated book on toy and model making worth the whole price. See our $500 "Hit or Miss" Prize offer in July number. You can enter this contest, open to every subscriber. Send your subscription at once. **INDUSTRY MAGAZINE,** Box P. M., Fairfield, Maine.



Where Can You Beat This?

An electric motor with wrought iron field magnet, 2" armature, pulley, entirely new design for 65 cents, postpaid. Induction coils, novelties, supplies, etc.

Catalog Free.

Artesian Electric Co. 1059 Columbia St. Chicago

WHERE JOHNNIE IS.

Ever since John went away
She would hold to this old map,
"Findin' Johnnie," day by day,
With it spread out in her lap.
Who was John? He was our boy—
Soldier boy—so full of fun;
Never cared to have a toy,
'Cept a sword, or drum, or gun.

So, when he was gone, I say,
Mother, she would sit and chat
With the map spread out this way
And the flag pinned "where John's at."
Nights, when I would lock the door
And go to put out the light,
She'd say: "Let me look once more
To find where John sleeps to-night."

By and by she seemed to fail—
Couldn't think what it might be
But her cheeks grew waxen pale
Where the roses use' to be.
But she never suffered so
That she couldn't find "John's place"—
And her eyes—how they would glow
When his marches she would trace!

Then, one day, the telegraph
Came that our boy John was—dead!
I can never tell you half
What I thought when that I read.
Mebbe it was wrong to do,
But to mother—Well, I lied;
Told her John was almost through
With the war, and then she cried.

Late one night I heard her say:
"Bring the map. I want to see
Where our Johnnie was to-day."
Then she looked straight at me
And picked up the map like this—
But her eyes looked on, and on,
And she cried out: "There he is!"
Then dropped back and whispered "John!"

This old map—I keep it here,
Smudged and tattered up this way.
And that blot? That is a tear
Markin' where John was one day.
That is where our Johnnie fell,
Fightin' with those men of his.
Mother knows—I couldn't tell.
Mother—she's "where Johnnie is."

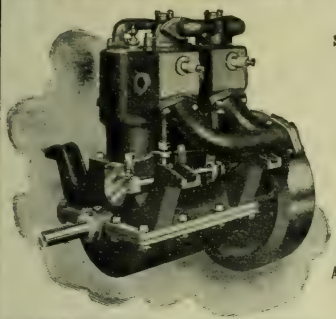
—Chicago Tribune.

NEW METHOD OF TESTING EGGS.

A new and simple method of testing eggs is now being used in Germany and is calculated to make the egg-candler's work much more speedy and accurate, writes U. S. Consul-General Guenther at Frankfort, Germany.

The air chamber in the flat end of an egg increases with age. When a fresh egg is placed in a saturated solution of common salt it lies in a horizontal position at the bottom of the vessel. When it is three or four days old the flat end is elevated so that the long axis forms a 20-degree angle with the bottom of the vessel. The older the egg the greater the angle. At three weeks it is 75 degrees, and at a month the egg stands vertical. By attaching a scale to the vessel it is possible to determine the age of the egg almost to a day.

AUTOMOBILE AND MARINE MOTORS



SIMPLE, COMPACT and POWERFUL

Best material.
Perfect workmanship.
Send for Catalog.

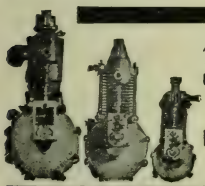
ALEXANDER & CROUCH,
71 W. Monroe St.,
Chicago

1, 2 & 4 Cylinder 4, 8 & 16 H. P.

A MOTOR-CYCLE AT SMALL COST

By using one of our Attachable Outfits. THOROUGHLY PRACTICAL. In USE FOUR YEARS. Also a complete line of Motors, Castings and Accessories for Bicycle, Automobile Marine or Stationary.
Send stamp for Catalogue.

STEFFEY MFG. CO.
Brown and Pnenock Sts., Philadelphia, Pa.



1¾ H. P. Bike Motor, $7.50

CASTINGS WITH DRAWINGS, Latest Model
We also have them in 2 1-2 H. P.

For fuller information address
Eureka Mfg. & Supply Company,
St. Paul, Minnesota

AUTOMOBILE PARTS

OF EVERY DESCRIPTION.
Write for Catalog and Prices.
OTTO KONIGSLOW,
CLEVELAND, OHIO

SPROCKETS

and EQUALIZING GEARS
IN STOCK OR TO ORDER.
Standard makes of Chain on hand.
Prompt delivery.....Catalogue free.
CULLMAN WHEEL CO., 522 Larrabee St., Chicago

ECLIPSE POCKET AMMETER

For General Battery Testing. 0 to 20 Amperes

Flexible cord attached and contact spur in case, which is DRAWN BACK INTO CASE, when carried in pocket. Size of watch and very light weight. Can be used in any position. Particularly designed for Auto use.

PRICE $5.00

ELDREDGE ELECTRIC MFG. CO.
227 Main Street, Springfield, Mass

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

WE CAN KILL THOSE

IGNITION TROUBLES

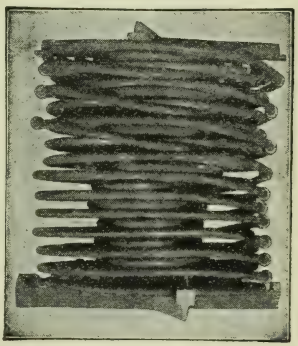
DURO BATTERIES ARE THE MOST DURABLE, COMPACT and EFFICIENT

The Only Way of Obtaining a Mileage Guarantee

Chicago Battery Co.
1421 Michigan Avenue, Chicago

Our New FLASH BOILER

For 1904



No burning of boiler—No water gas—No smoke
Absolutely Non-explosive.

OUR PERFECT **KEROSENE BURNERS**

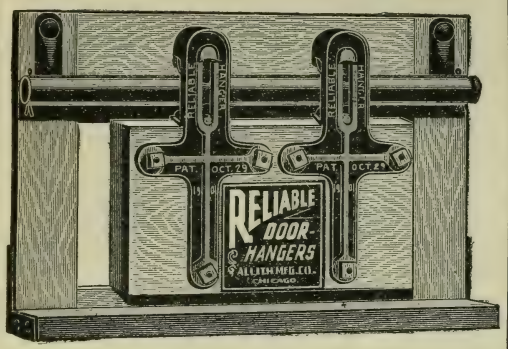
Condensers, and other appliances are marvels of mechanical development.

Barton Boiler Company
SOLE MANUFACTURERS,
4230 State St., Chicago, Ill., U. S. A.

Write for full particulars

KEROSENE OIL ENGINE
Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago

THE "RELIABLE ROUND TRACK
DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks
Ours Will Not Bind
Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.
120 South Green Street, Chicago

SEE SPECIAL OFFER
ELSEWHERE OF OUR NEW BOOK
"Popular Mechanics Shop Notes"
JUST OUT

WE BUILD GASOLINE ENGINES
Automobile, Marine and Stationary
Transmission, Gears, Carburetters, Pumps, Mufflers, &c.
Write for circular and prices before ordering
W. B. MURRAY, 1253 Milwaukee Avenue, Chicago

EVERY FALL
We Issue a BARGAIN Sheet Just To Get Rid of Our Goods.
AUTOMOBILE THINGS YOU NEED.
WE NEED THE MONEY.
WRITE AWAY; RITE FOR IT.
The MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago
IT - IS - UP - TO - YOU

BEES CAME DOWN THE CHIMNEY.

A Minnesota man had a most unusual experience with a swarm of bees not long since. His family was away from home and when he entered the house in the evening a peculiar sound that seemed to come from everywhere at once greeted his ears. It did not take the gentleman long to find out that the house was completely filled with bees. They had come down the chimney, and through the fireplace and were buzzing angrily about, not yet decided on settling down. The Winona Republican and Herald gives a graphic account of what followed:

Their greeting was warm, but not what could be called cordial. Mr. Casey rushed upstairs, shooing the insects off as he ran, threw a pillow case over his head, tied strings around the bottoms of his pant's legs, and put on some old baseball gloves. Not knowing much about the bees, he tried building small fires in the different rooms,using his wife's best kitchen-ware for fireplaces. But the bees wouldn't be smoked out. They seemed to like it.

They were by this time getting in their work on his protective armor, and in mortal terror lest they find a vital spot and put him out of action, the quondam head of the house fled precipitately. A man down town told him to get a bee fancier who could hive the bees for him. The man without a home hunted up the bee expert.

"About seven million bees have taken possession of my house; came down the chimney," he began.

"Lucky for you," replied the entomologist enthusiastically. "They're worth $15."

"Not till they're dehorned; no, not to little Will," replied the amateur apiarist decidedly. "What I want is a bee cowboy that can round 'em up and lasso 'em; they've got to be caught, corralled, drowned, smoked out, decapitated, or some old thing before I can go home. Might have known something 'd go wrong when my wife left town."

"You wan't 'em hived do you?" demanded the apiarian.

"I don't know whether that's what I want or not," replied the discomfited householder. "I want 'em ejected, thrown out, ordered off; and then I want a plank nailed over the top of the chimney. Say, suppose they make honey all over the floor and fill the grate with it?"

The beeman smiled.

"Do I get the bees if I get 'em out?"

"You bet you do; you'll get good and plenty of 'em too, if they're feeling as ugly as they did when I left 'em. You can have 'em if you'll agree to take 'em away far enough so they won't know the way back."

And so it was done. The beeman took a hive, set it up in the Casey parlor, made a few passes at the queen bee, and lugged off a $15 tribe of honeymakers. Mr. Casey didn't even regret their going, but he looked under the bed before he retired that night.

HOW SEA BIRDS DRINK.

"When I was a cabin boy," said an elderly sailor, "I often used to wonder, seein' birds thousands of miles out to sea, what they done for fresh water when they got thirsty. One day a squall answered that question for me. It was a hot and glitterin' day in the tropics, and in the clear sky overhead a black rain cloud appeared all of a sudden. Then out of the empty space, over a hundred sea birds came dartin' from every direction. They got under the rain cloud and they waited there for about ten minutes, circlin' round and round, and when the rain began to fall, they drank their fill. In the tropics, where the great sea birds sail thousands of miles away from shore, they get their drinkin' water in that way. They smell out a storm a long way off; they travel a hundred miles, maybe, to get under it, and they swaller enough rain drops to keep them goin'."—Portland Oregonian.

Novelties Made to Order

we'll show you how to place your invention on the market and make money.

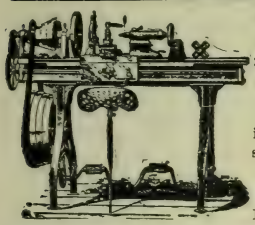
Metal Stamping

We make Dies and Tools that will turn work out cheaply. Write us—

CHICAGO RIFLE MANUFACTURING CO., 11-21 SO. JEFFERSON ST., CHICAGO

CRANE VALVES

ESTABLISHED 1855



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

POPULAR MECHANICS

Cen give you the address of the maker of any

MACHINE OR TOOL

FOOT and POWER

AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.

A131 W. 2d St., Cincinnati, Ohio

AUTOMATIC —PIPE— WRENCH

Strongest
Simplest
Best

It is self-adjusting and self-releasing. It never gains. Made in three sizes, 10-inch, $2.00; 16-inch, $2.75; 24-inch, $5.00, express prepaid.

H. P. VAN NESS

607 Northern Office Bldg., CHICAGO, ILL.

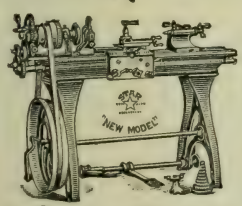
If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

POPULAR MECHANICS CO.

"STAR" FOOT AND POWER LATHES



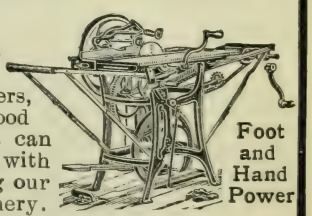
Are used extensively by repair shops, tool-makers, gun-smiths, experimental and model makers, etc.

Built for durable and fine accurate service, containing throughout the highest type of modern construction. 9 to 14 inch Swing

SEND FOR CATALOG "B."

Wood Working Machinery

COMPLETE OUTFITS



Foot and Hand Power

Carpenters, builders, cabinet-makers, wood workers and others can successfully compete with large shops by using our labor-saving machinery.

SEND FOR CATALOG "A."

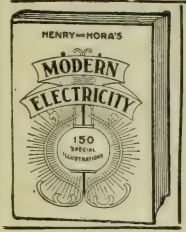
THE SENECA FALLS MFG. CO.

102 WATER STREET, SENECA FALLS, N.Y., U.S.A. Adv. No. 44.

Greatest Electrical Book

Modern Electricity

By HENRY & HORA



Is full of information invaluable to you if you are interested even remotely in this great science. It is a new and most complete encyclopedia containing full descriptions of electrical devices and machinery, systems of transmission and distribution—treating most minutely every important branch, including X-Rays, wireless telegraphy, radium, power stations, wiring, etc. In compiling this book the authors have studiously avoided theories and technical phrases which discourage the efforts of the average reader. Modern Electricity is written in that plain good English so desirable to everyone and appreciated as well by experts. 355 pages, Cross index.

THE PROBLEMS OF ELECTRICITY SOLVED

A boon companion for the electrical engineer, workman, apprentice or student.

PRACTICAL : ACCURATE : SCIENTIFIC

But above all simple
Absolutely original matter prepared by expert electrical engineers, never published before.

150 ILLUSTRATIONS

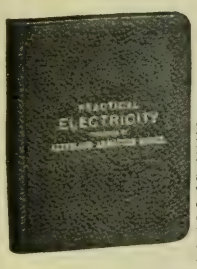
drawn especially for this work.

Silk Cloth Decorative Cover, Silver Stamping, : : : $1.00
Seal Leather, Marbled Edges, Gold Stamping, : : : : 1.50

Laird & Lee's Imprint on Scientific and Mechanical Books Guarantees Reliability.

AT YOUR DEALER'S OR
SENT POSTPAID ON RECEIPT OF PRICE.

LAIRD & LEE, PUBLISHERS, 263-5 Wabash Av. **CHICAGO**



A School Within Itself

Space will not permit our telling you all about this book, but better still, we give you a chance to examine it for yourself by our offer to refund money if book is not satisfactory upon examination. Under this offer, 11,000 copies have been sold and paid for, and out of this number we have refunded for only fifteen copies. There are nineteen chapters, carrying you from the fundamental principles of electricity through the art to the finished dynamo. Contains a dictionary defining 1,500 words.

3rd Edition. Price, $2.00 delivered.

CLEVELAND ARMATURE WORKS, Cleveland, Ohio

FREE Catalogue of Architectural, Scientific and Technical Books —Prospectus for 1904, for Architects and Builders' Magazine" monthly.

$2.00 a Year

WM. T. COMSTOCK, Publisher, 23 Warren St., N. Y.

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute
97 Washington St., Chicago, Ill.

HOW SHALL THE INVENTOR INTRODUCE HIS INVENTION?

To the Editor:—After an inventor has secured his patent, say, for some small article for domestic use, what is the next step for him to take in order to introduce it to the public, and at the same time get some slight returns out of its sale for himself?

G. E., Paterson, N. J.

In reply to your request for information as to the best way for an inventor to introduce his invention into public use, we submit the following:

If you are so situated that you can economically manufacture the invention and place it on the market yourself you should do so, at least until you have established a demand for the article among the trade. You should first have some samples made up in the best style possible and take them to the retail trade, selling outright if possible at a small margin, or, if necessary, placing the goods on commission. At the same time you should advertise the goods as effectively as possible, and to do this it is usually economy to consult a professional advertising expert, as advertising is a business that requires expert knowledge as much as any other business. If the goods sell well then take up the matter with jobbers and try to sell to them. If the jobbers refuse to handle the article, continue to offer it to the retail trade until a demand is thoroughly established, when you will have no difficulty in securing customers among the jobbers. If the returns justify giving the matter your exclusive time and attention, or the organization of a company to take it over, the question of manufacturing the article as cheaply as possible should be carefully investigated with a view of making it a permanent business. If, however, the sales are limited and there seems to be no prospect of increasing them materially because of lack of means or selling ability, the best plan is to turn the article over to some manufacturer making similar articles and receive a royalty.

If you are not in position to manufacture and introduce the article in the manner above mentioned, your best recourse is to take the device in the first place to a manufacturer of similar articles and have it made and sold on a royalty. To grant a license for the manufacture of an invention in consideration of a fair royalty will usually bring the greatest returns to the inventor—returns exactly in proportion to the invention—provided the article is made and sold by the manufacturer having the best facilities for making and selling it; that is, the manufacturer who is so equipped as to be able to produce the article at the least possible cost, and whose facilities for selling that particular device are unsurpassed. Such a combination means that the article will be sold in the very largest quantities; and the manufacturer's fitness for handling it will keep imitators out of the field. Care should be exercised in making contracts under royalty conditions to see that the inventor's rights are fully protected. It is a fact that few inventors have the business ability to handle commercially their inventions. They need the assistance of business men and usually those who have had experience in introducing new articles to the public. A peculiar ability is required to insure success in this line and it is usually economy to secure the services of one having such ability.

Always perfect your samples before submitting them to manufacturer or dealer. Submit your samples to several manufacturers and make a deal with the one who is rated best by Bradstreet's, is best equipped to sell your article and who will give you

THE American School of Correspondence offers every man who wants to learn something about ENGINEERING an opportunity to do so NOW at unusually favorable terms.

Write for our FOUR GREAT SPECIAL OFFERS (not in force after November 1) regarding our courses in

ENGINEERING

TAUGHT BY MAIL

Electrical Engineering

Central Station Work.
Electric Lighting.
Telephone Practice.
The Electric Telegraph.
Electric Wiring.

Mechanical Engineering

Sheet Metal Pattern Drafting.
Shop Practice.
Boiler Makers' Course.
Tool Makers' Course.
Sheet Metal Work.
Metal Roofing.
Cornice Work.
Tinsmithing.

Stationary Engineering

Marine Engineering.
Locomotive Engineering.
Boilers and Engines.
Special Refrigeration.
Engineers' Course.
Firemen's Course.

Civil Engineering

Municipal Engineering.
Structural Engineering.
Railroad Engineering.
Surveying.
Hydraulics.
Structural Drafting.

Sanitary Engineering

Heating, Ventilating and Plumbing.
Heating and Ventilation.
Plumbing and Gasfitting.

Architecture

Architectural Engineering.
Contractors and Builders.
Architectural Drawing.
Carpenters' Course.

Textile Manufacturing

Complete Cotton.
Complete Woolen and Worsted.
Complete Knitting.
Cotton Spinning.
Woolen and Worsted Spinning.
Warp Preparation and Weaving.
Textile Design.
Textile Chemistry and Dyeing.

Mechanical Drawing

Perspective Drawing

College Preparatory

Complete Preparatory.
Special Mathematics.
Sp. Mech. Drawing

200-Page Bulletin and full information regarding any particular course free on request.

NOW IS THE TIME if you are thinking of studying this winter. Get to work early and you will be earning more money by Christmas.

The attached coupon has money value for you. Cut it off and mail it to us TODAY.

CUT OFF ALONG THIS LINE

AMERICAN SCHOOL OF CORRESPONDENCE
at
Armour Institute of Technology, Chicago.

Please send me full information regarding your four special offers regarding your course.

Name .....

Address .....

City .....

State .....

Pop. Mech.
Oct.

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building . . WASHINGTON, D. C.

What Is Daus' Tip-Top?

TO PROVE that Daus' "Tip-Top" is the best and simplest device for making **100 copies** from pen-written and **50 copies** from typewritten original, we will ship complete duplicator, cap size, **without deposit**, on **ten (10) days' trial.**
Price $7.50 less trade discount of 33⅓%, or **$5 net**
THE FELIX F. DAUS DUPLICATOR CO.
Daus Building, 111 John St., New York City.

THE WINGET **CONCRETE BUILDING BLOCK MACHINE**

Automatic Adjustable
Makes any size or shape block required in ordinary building operations
Straight & Corner Block
A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

LOW PLUMBING BILLS
Get them by paying right prices for supplies. We sell
SUPPLIES AT WHOLESALE
You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.

B. P. KAROL,
229 W. Harrison St., Chicago.

METAL BREAD BOARD
Reversible—No wood about it. Hygienic, sanitary, low-priced. Cannot crack, split nor warp. **Lasts Forever.** Every woman wants one. Sample postpaid 25c
Agents Wanted.
LYONS MFG. CO.,
15 Day St., PEKIN, ILL.

MAGIC

I will teach you one new coin trick and one new card trick for 20 cts. or either for 10 cts. I will send *"Book of Card or Coin Tricks,"* 180 p., 25c. each, and include illus. catalog of 240 tricks free with order. Learn at home, amaze your friends, mystify, startle and entertain. ROBERT WASSMANN, Instructor in Magic, 227-z Webster Ave., CHICAGO, ILLINOIS.

50 Cents

ELECTRIC MOTOR
The Rienco Motor runs at high speed when connected to one cell of almost any kind of battery. It rotates in either direction and is reversed without changing connections. It is fitted with grooved pulley. Price, 50 cents. Postage and packing, 15 cents
Motor Outfit No. 8
consists of 1 Rienco Motor; 1 Rheostat, or speed regulator; 2 Small Dry Batteries and 10 feet of wire. Price, $1.00. Postage and packing, 30 cents. Send stamp for catalog.
Ithaca Electric Nov. Co., Inc. Box 64, Ithaca, N. Y.

Send for
POPULAR MECHANICS
PREMIUM LIST
Just Out

the fairest contract. Never make a contract without first submitting it to your attorney. This is the rock on which most inventors founder. Don't part with the title to your patent until the money has been paid or its equivalent contracted for.

These are a few of the things to do and not to do. Individual cases require special treatment, and what has been said applies only to the average state of facts.

HINTS TO INVENTORS.

The trouble that farmers have had this summer in trying to get harvest hands would be simplified to some extent if somebody would invent a new implement for the hay field, says the Implement Age. There ought to be some way for the farmer to get his hay from the swath into the barn without the help of hired men, who are so hard to find. The manufacturers of hay-making implements may say that this is impossible, and that the implements they now furnish are the best that human ingenuity can produce, but American inventors are always doing impossible things.

The hay harvest is the sticking point in the American system of agriculture. With the exception of haying time, a farmer, on an average, diversified farm, can do all his field work without hiring help, from the first furrow of spring to the last wagon load of corn in the fall. One man can harvest an average field of wheat or oats, of the size that we find east of the Mississippi, by running a binder in the morning and leaving the team in the stable while he shocks in the afternoon. And in the same way the farmer could mow his grass and shake it up with a tedder in the forenoon, and in a week of haying season he could take care of the hay crop of the average farm, if there were only some way in which one man could go it alone in hauling the crop to the barn in the afternoon, so as to take care of what he can mow and ted in the morning.

The hay loader has proved a valuable implement to the busy farmer, especially on large stock farms. One loader will keep two or more wagons going in hauling to the barn, if there are enough men to take care of their part of the work. The average farmer, however, only raises 20 to 30 acres of hay, and he likes to be independent of hired help and his neighbors, and he would not need any help in taking care of his hay crop if some ingenious inventor would kindly give him the right kind of help in the afternoon.

STRANGE PET OF A BORNEO WOMAN.

The wife of the governor of North Borneo has a pet which few women will envy her. The governor's house is near a jungle, and from it strayed a baby rhinoceros. Captured as a curiosity, he at once became tame and refused to return to his native wilds. He consumes sixteen quarts of milk a day, and on this diet thrives and grows fat. He might be mistaken for a queer sort of hog were it not for the horn in the middle of his face. He is devoted to his mistress and follows her about like a dog.—London Standard.

ELECTRIC RAILWAY IN LIFE-SAVING SERVICE.

An electric railway in Ohio has made arrangements to carry the life-saving crew to points of emergency along the lake, whenever necessary. Captain Abbott concluded negotiations with the company for this purpose a few days ago. A complete outfit will be kept on a flat at Lorain, and the car will be run out at the call of the life-saving station. This road runs along close to the lake almost the entire distance to Toledo from Cleveland. At least, it touches all the important points. The steam roads may be used to some extent also, where any point can be reached quicker and better in that way. Between Lorain and Sandusky, however, the electric road will be used almost entirely.

THE ENGINEERS WE'VE HAD.

The Know-it-all Engineer.

There wasn't a thing invented, and there wasn't a new machine,
But what our Jim knew all about ere they were even seen.
There wasn't a plan proposed by man, that he couldn't knock out flat,
And there wasn't a rule you mentioned, but he had it all down pat!
But he never seemed to know these things 'till some one told him how
The things were done or figured. Then you ought to see him bow
His head in swift approval of the plans—then he would roar:
"That's right enough, my hearty, but I knew it all before."

One day, the boss brought in a friend, who looked at Jim so queer,
He drew himself up "dignified," and said: "I'm engineer,
And now, sir, if there's anything you'd really like to know
About this plant, I am the only one these things can show."
The boss walked off a smilin', and the stranger bowed with grace,
And said to Jim, "I'll be real glad to look around the place.
But show me where you get the steam to make your engines go."
"Come on, my friend," said Jim, "for there is nothing I don't know."

They came into the boiler room—"them's bilers, sir," said Jim,
At that we winked and smiled, then started in our coal to trim.
"Them's bilers, and that's where we get the pressure of the steam.
The fire boils up the water, when the pump sends in a stream."
"They must be strong?" the stranger said, "you bet they are," said Jim,
"How strong are they?" "Well now, I knew, but memory does get dim."
"How do you tell?" "Well, come around here in a day or so.
I'll look it up again," said Jim, "and then I'll let you know."

"How many braces have they? What strain is on each brace?"
—And then we noticed that poor Jim grew paler in the face.
"What is their tensile strength? How long? How many flues have they?"
—And Jim stood with an open mouth, and not a word did say.

(Continued on next page.)

The World's Headquarters for
ELECTRIC NOVELTIES and SUPPLIES
If It's Electric We Have It.—We Undersell All

Fan Motors, $2.00 to	$15.00
Battery Table Lamp,	3.00
Battery Hanging Lamp,	10.00
Telephone, complete, $2.50 to	5.95
Electric Door Bells,	1.00
Electric Carriage Lamps,	5.00
Hylo Turn-Down Lamps,	.60
$8 Medical Batteries,	3.95
$12 Belt, with Suspensary,	2.50
Telegraph Outfits,	2.00
Battery Motors, $1.00 to	12 00
Bicycle Electric Lights, $2 to	3.50
Electric Railway,	3.25
Pocket Flash Lights,	1.25
Necktie Lights,	1.00

SEND FOR FREE BOOK.

$3 ElectricHand Lantern. **Agents wanted.**
OHIO ELECTRIC WORKS, -- Cleveland, Ohio

A Phonograph Improvement!
TIZ-IT THE NEW
Allmetalballandsocketswiveljoint
For Reproducing and Recording.

HORN CONNECTION
A great improvement over the old connection. Soft rubber deadens the sound. TIZ-IT will increase the volume of tone, making it louder and clearer. If your dealer don't sell them, send 50cts. to J. W. Kreiling, Inventor and Manufacturer, 855 North 40th Avenue, Chicago, Ill.

BOYS, WRITE TO US
and let us show you how easy it is to become an electrician. Our catalog for boys shows everything in motors, dynamos and electrical goods. Sent free to anyone. As a special inducement we send this motor for $1.50 with directions for operating. Send 15c in stamps to pay mailing charges. Julius Andrae & Sons Co., 483 West Water St., Milwaukee, Wis.

$1.50

Every Boy His Own Toy Maker
Tells how to make all kinds of Toys, Steam Engines, Photo Cameras, Windmills, Microscopes, Electric Telegraphs, Telephones, Magic Lanterns, Æolian Harps, Boats, from a rowboat to a schooner; also Kites, Balloons, Masks, Wagons, Toy Houses, Bow and Arrow, Pop Guns, Slings, Stilts, Fishing Tackle, Rabbit and Bird Traps, and many others. All is made so plain that a boy can easily make them. 200 handsome illustrations. This great book by mail, 10c, 3 for 25c.
Western Specialty Co., 16, E. 5th St., St. Paul, Minn

BE YOUR OWN BOSS
MANY MAKE $2,000 A YEAR
You have the same chance. Start a Mail Order Business at home. We tell you how. Money coming in daily. Enormous profits. Everything furnished, Write at once for our "Starter" and FREE particulars.
P. M. Krueger Co., 155 Washington St., Chicago, Ill

MARRY **Wealth-Beauty**
Marriage Directory FREE TO ALL. Pay when married. Entirely new plan. Send no money for particulars. **Select Club, Dept. 448, Tekonsha, Mich.**

Mounting a Wild-Cat.

We can teach you how.

LEARN TAXIDERMY BY MAIL.

WE CAN TEACH YOU to correctly mount Birds, Animals, Heads, etc. Taxidermy is indispensable to the sportsman and naturalist. Adapted to all persons inclined toward MECHANICS or ART. Easily and quickly learned. Learn in your own home during your spare time. Save your fine trophies. Decorate your home and office. Double your income. Best methods, reasonable tuition, highest references, satisfaction guaranteed. You may have our new illustrated catalog for the asking. WRITE TODAY.

The Northwestern School of Taxidermy, Suite 58 Com. Nat'l Bank, Omaha, Nebraska

We Mount Specimens RIGHT at RIGHT PRICES.

$40.00 A WEEK.

Reliable man or woman each county as manager to exhibit, take orders, appoint agents for **Harrison Valveless Oil-Gas Stoves. Wonderful Invention** — beats others — Automatically generates fuel gas from kerosene—**Miniature gas works**—Absolutely safe—Enormous demand—**Splendid for summer cooking**—Delight customers—Cheap, clean, safe fuel. **Gasoline is dangerous. Catalogue Free.** Write today. **WORLD MFG. CO., 5687 World B'ld'g., Cincinnati, O.**

Magic Trick Cards.

With these cards you can perform some of the most wonderful illusions You can change eights to duces, blacks to reds, etc, The transformations are truly wonderful. **Price, 10 cents** with instructions, and our Big Bargain Catalogue.

Address

Western Specialty Co., 16, E. 5th St., St. Paul, Minn.

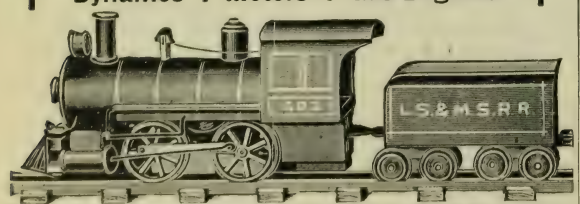
MAKE YOUR OWN MIRRORS

And make big money making mirrors for others. Success guaranteed. We will send complete printed directions and formulas for making mirrors, boring holes in glass, frosting, foiling, gold leafing, embossing, chipping, etching, also how to etch photos on glass, etc., all for $1. Address

G. L. Patterson & Co., Chicago, Ill.

ELECTRIC RAILWAYS

Dynamos : Motors : Gas Engines



Complete Working Models, also Castings and Parts. Everything for the Amateur Electrician. Send for Catalogue B

The CARLISLE & FINCH CO.,

262 E. Clifton Ave. Cincinnati, Ohio

"What is the surface of the grates? How high's your bridge-walls then?
How often do you clean them?"—Here Jim woke up again.
"Oh! when the mud shows in the water in that glass."
The stranger said, "My man, I am afraid that you'll not pass."

"Say, who are you?" Jim hollered, "that you dare to question me?"
"I'm just the new inspector. Now, your license let me see."
Jim brought it, and the stranger, taking it from out its frame,
Just fired it in the furnace, where it soon went up in flame.
Poor Jim! Next day a letter from the boss for him arrived,
Which said: "We're sorry, James, but from the answers he derived
From you about our boilers, the inspector wishes much
That we discharge you, which we do—because you know too much."

—Practical Engineer.

A BIRDLESS WORLD.

A naturalist says that if the world were to become birdless, man could not inhabit it after nine years' time. In spite of all the sprays and poisons that could be manufactured for the destruction of insects, such pests would simply eat up orchards and crops.

COAL STORED BY COMPRESSED AIR.

"The strength of Gibraltar" has become a byword of nations, yet those using it little realize all it means. The strength of that fortification is well illustrated by the manner in which coal is stored. This is done by a very curious plant, which has just been completed for the pumping station at Landport.

"The coal store, boiler house and the engine room adjoining are worked under compressed air, and are necessarily airtight. The store to which the coal has to be conveyed is hewn out of the solid rock, and is absolutely bomb-proof. A special feature is the arrangement of the coal plant in such a way that it does not interfere with the air pressure. The coal is lifted from the coal tip 57 feet below the horizontal traveler. The skip by which the coal is conveyed is raised by means of a steel wire rope, working over pulleys and round a driving drum. The skip is lowered into a receiving hopper, where it discharges. At the bottom of the hopper is an automatic arrangement, consisting of a hinged door controlled by a lever and a balance weight; this door opens when there is sufficient coal in the hopper to overcome the balance, closing again as soon as the coal is discharged, and thus avoiding the escape of air. From this point the coal gravitates into the coal store, where it is used in the boiler house for generating steam for pumping purposes. The time occupied by the skip in traveling from coal tip to coal store is two minutes. At this end, and on a level with the motors, a sentry-box is hewn out of the rock, where the man who controls the gearing for hoisting the skip is housed, and has practically a full view of all three operations.

THE FISSURE FISHER.

A fishy old fisher named Fischer,
Fished fish from the edge of a fissure.
A cod, with a grin,
Pulled the fisherman in—
Now they're fishing the fissure for **Fischer!**

PEANUTS and POP CORN

A BUSINESS THAT PAYS

Machines are earning from $35 to $60 per week. Catalog Free.

S. DUNBAR & CO.
18 & 20 No. Desplaines St.
CHICAGO

BIG PAYING BUSINESS
FOR MEN AND WOMEN.

Write for names of hundreds of delighted customers. Make $80 to $50 weekly. Do business at home or traveling, all or spare time, selling Gray outfits and doing genuine gold, silver, nickle and metal plating on Watches, Jewelry, Tableware, Bicycles, all metal goods. Heavy plate. **No experience,** quickly learned. Enormous demand. **No toys or humbug.** Outfits all sizes. **Everything guaranteed. Let us start you. We teach you FREE.** Write today. Address,

H. GRAY & CO., Cincinnati, Ohio.

AGENTS WANTED Sell our $1.00 bottle of Sarsaparilla for 35c; best seller; 200 per cent. profit; write today for terms and territory.
F. R. GREENE, 116 Lake Street, Chicago

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,
127 NASSAUST. ROCKFORD, ILL., U. S. A.

AN INCOME FOR LIFE

I will send you **free,** booklet telling how to make $1 earn $10, larger amounts in proportion. A few of your idle dollars invested will bring an income for life Send no money, booklet is free. Just a few left. Address

J. B. LAWRENCE, 112 Michigan Street, CHICAGO

Common Red Clover

Cures Cancer, Eczema, Salt-Rheum, Rheumatism and all other Blood Diseases

How many people realize the true value of our common red clover? It is the best blood purifier known. Thousands of prominent people have been cured of cancer, rheumatism, constipation, eczema, skin and blood diseases by its use. Send your address to D. Needham's Sons, 116c Lakeside Bldg., Chicago, Ill., and they will mail free a full description of Red Clover Blossom Extract, a history of how Mr. Needham cured his cancer and testimonials from many who have used the remedy. If you have any disorder of the blood look into the merits of Needham's Clover. It is the best blood purifier known.

RUPTURE

Our 24-page book free describes the greatest invention of the 20th Century, for the relief and cure of Rupture. Shows interesting photos from life and contains new and valuable information. Greatest trial offer ever made by any firm. You will be interested. Write today.

DENCE & MERY, 160 Mery Block, Toledo, O.

THREE OUT OF FIVE

Men suffering from weakened nerve force, constant depression, gloomy forebodings, fast becoming unfitted for active business life, fail to attribute their deplorable state to the proper cause. They know they

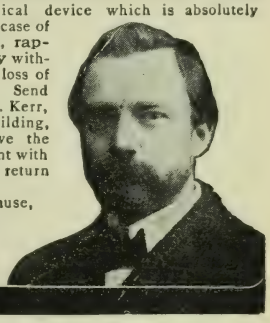
HAVE VARICOCELE

as they have suffered much discomfort on account of it, particularly while standing. But the evil effects due to Varicocele are so gradual that they neglect it until the entire system is undermined and they are forced to realize that something must be done to prevent them from breaking down completely. To such sufferer I say, don't fall into the hands of Quacks—don't submit to the knife—don't pay enormous sums to so-called specialists—

Cure Yourself at Home

I have successfully treated and cured thousands of cases with a patent mechanical device which is absolutely guaranteed to cure any case of Varicocele painlessly, rapidly and permanently without inconvenience or loss of time from business, Send only **$2.00** to Mark M. Kerr, M. D., 703 Park Building, Cincinnati. and receive the full guaranteed treatment with simple instructions by return mail.

A treatise on the cause, effect and cure of Varicocele sent sealed **FREE OF CHARGE.**



A CLOSE SHAVE

That is what we are giving to the price on this Razor Strop. It is not a fancy article with nickel-plated fittings, etc., but all the value is put into the leather.

An Honest Strop for an Honest Price. Sent Postpaid, 50c. **Sterling Supply Co.,** 56 Fifth Ave., Chicago, Ill.

Glogau's Alcohol-Gas Stove

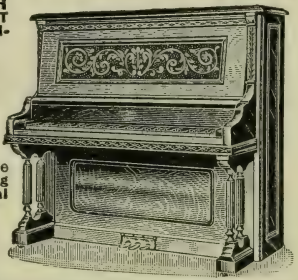
Can do everything a gas stove does. **Indispensable** for nursery, sick room, Chafing Dish, shaving; for tourists, boarders, hunting, fishing, or **wherever gas is not available or desirable.** Vaporizes alcohol into gas, increasing **its efficiency 8 times.** Portable, weighs but 8 ounces. **Consumes but 2 cts. worth** of alcohol **an hour.** Will boil quart of water in 9 minutes. Smokeless and odorless. Reservoir holds half a pint. Uses either wood or grain alcohol. Simple; cannot get out of order. Safe; will sustain weight of 100 lbs. Extinguishes instantly (blows out like a candle). **Non-explosive.** Solid Spun Brass and **NICKEL PLATED.** Sent anywhere, postpaid, **$1. Agents Wanted.**

P. M. GLOGAU & CO., 40 Dearborn St., Chicago.

WONDERFUL PIANO OFFER.

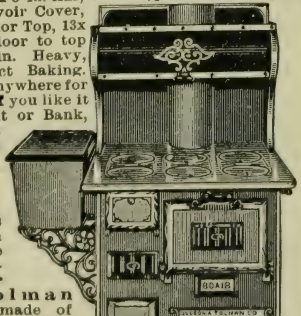
The Celebrated BECKWITH PIANO CO.'S UPRIGHT GRAND 25-YEAR GUARANTEED PIANOS

$89.00, $115.00, 138.00, and 165.00.



For the most liberal piano offer ever heard of write for our **Free Piano Catalogue,** and you will receive by return mail, free, postpaid, the **handsomest, most interesting and most complete Special Piano Catalogue ever published.** We will send you a facsimile of our celebrated 25-year guarantee, our one year's free trial plan will be fully explained, how we furnish pianos on trial without one cent of money being sent to us will be made very clear; you will receive facsimile letters from the largest Chicago banks endorsing our proposition and we will explain just what the freight will be to your town. In the special catalogue we show large, handsome, halftone illustrations and complete descriptions of all the different parts, the manner of construction (interior and sectional views), also color tone sample plates of the different woods, including French burled walnut, English quarter sawed oak, San Domingo figured mahogany, etc. Each piano is shown in very large halftone, full plate illustrations, every detail is fully and accurately described. **Why the highest grade Beckwith Piano made, the Acme Cabinet Grand Concert Piano at $165.00, is in every essential point the equal of any piano made, regardless of price, is made very clear.** Write for our **Free Piano Catalogue** and get all this free by return mail, postpaid; our latest and most astonishing offer, the greatest piano proposition ever heard of. If you have **any use for a piano at any price,** don't fail to write for **our Free Piano Catalogue and Offer.** Address, **SEARS, ROEBUCK & CO., CHICAGO, ILL.**

$45.00 TOLMAN Steel Range 23.75



Exactly as shown with **15 Gal. Reservoir and Hi Closet.** Six 8 in. lids, oven 17½x21, size of top not including Reservoir Cover, 28x36 in. Reservior Top, 13x24 in., height, floor to top High Closet 55 in. Heavy, Durable, Perfect Baking. We ship range anywhere for examination. If you like it pay R. R. agent or Bank, $23.75 and freight and take range home for

30 Days Free Trial

If not exactly as represented in every way, we **cheerfully return your money. Tolman Ranges** are made of best Wrought Locomotive Steel Plate. Thoroughly rivited. Oven plates braced. Flues lined with Asbestos. Burn any kind of fuel

Guaranteed Five Years Will save their cost in **one year.** We deliver exactly what we advertise. Send order, or send for our Catalogue E today,

JUDSON A. TOLMAN COMPANY
Dept. W-70. 66 Lake Street, Chicago

CLOCK TIME TABLE.

A unique and ready reference time table is in use on one of the suburban lines of the road between Liverpool and Southport, England. The cut will give an idea of the "clock" which is printed in two colors. The Railroad Gazette says:

All that is necessary is that the number of min-

Clock Time Table.

utes past the hour at which the train leaves a certain station be placed against that station by rotating the disk, and the exact time at which the train arrives at each of the other stations will be shown by the figures opposite them on the disk.

QUEER GOLD MINE.

Butchers of Bethnal Green, London, were surprised recently at the sudden popularity of sheeps' heads with their customers. They could not begin to supply the demand. Inquiry developed the fact that gold had been found in the teeth of the sheep which had been shipped in cold storage from Australia. The sheep evidently came from some region where there are gold outcroppings on the surface, and close grazing left some of the particles in the teeth of the sheep. An attempt will be made to ascertain from what region the sheep were shipped. —New York Tribune.

BURNING MONEY IN WAR.

Some idea of the cost of modern warfare can be arrived at by taking a Japanese war ship like the Kasuga or Nysshin and calculating the number of shots she would discharge. The first-named ship carries four cannon, which cost $30,000 each. One of these guns can fire two shots per minute, and every shot costs $400; thus in five minutes these four cannon can discharge forty bombs at a cost of $16,000. The smaller cannon cost each $18,000, and every shot they fire means an expenditure of $70. They are very rapid, and it is estimated that in five minutes the twelve cannon could discharge shot to the value of nearly $35,000.—Leslie's Weekly.

A TOAST.

The Russians are brave, the Japs are braver.
Long may they wave, but never waver.

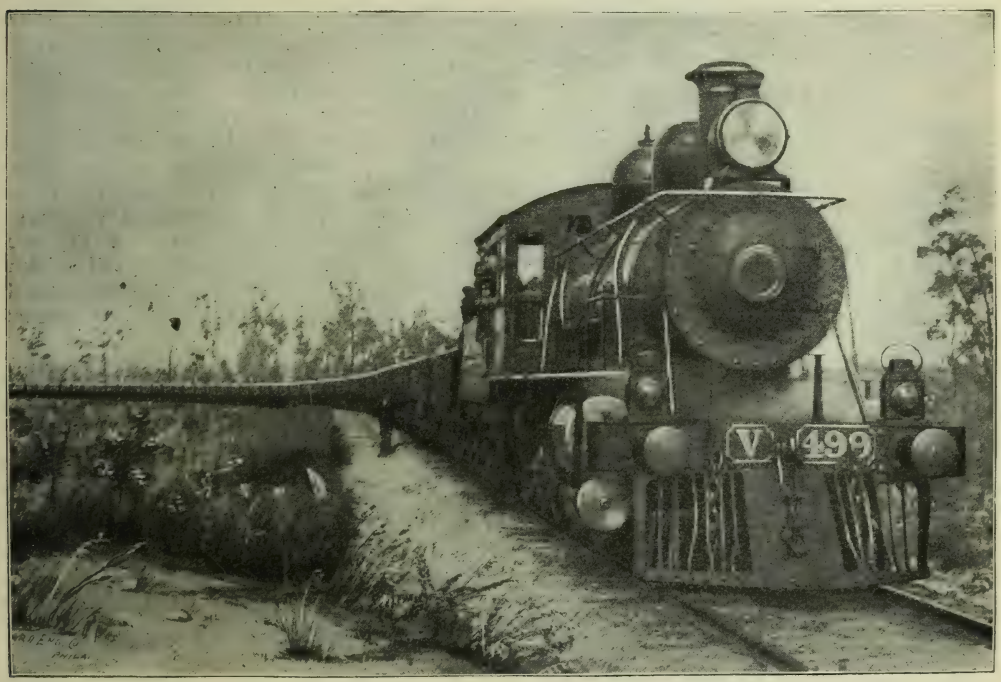
Policemen stationed at Lincoln Park, Chicago, will use a system of red light signals and stop watches to catch scorching automobilists at night.

POPULAR MECHANICS

Vol. 6. No. 11. CHICAGO, NOVEMBER, 1904. 10 Cents a copy $1.00 a year.

Victoria's Longest Train

Consolidation Type Hauls 54 Cars Weighing 781 Tons Over Heavy Grades



Government Railways of Victoria—Test Train

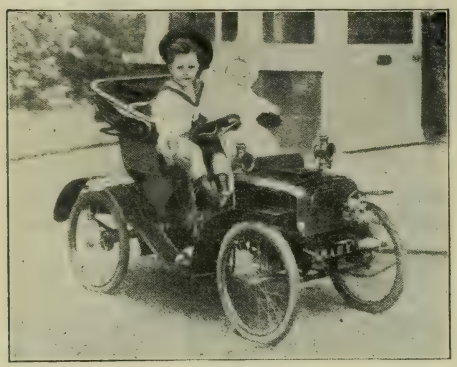
Fifty-four cars including a caboose, composed a test train hauled over the Government Railways of Victoria recently, between Nyora and Melbourne. The train, exclusive of engine and tender, weighed 781 tons and is the heaviest train ever hauled in the colony of Victoria.

The train was pulled by a consolidation locomotive of the Vauclain compound system. The ruling gradient on the line was one in 75 or a raise of 70 feet per mile. So successful was the test that all the Government Railways are to be equipped with this type of American-built locomotives in the future.

American-built engines are found at the remotest corners of the globe, and it would be hard to convince the average American that any locomotive of foreign construction could surpass some of those put out by our renowned companies. In several recent constructions, however, foreign types have been adapted to American practice without departing from the symmetry and pleasing arrangement obtaining in American types.

BABY AUTO FOR INFANTS.

An automobile only 4½ feet long and 1½ feet wide was a prize winner at a recent contest in England. The engines develop

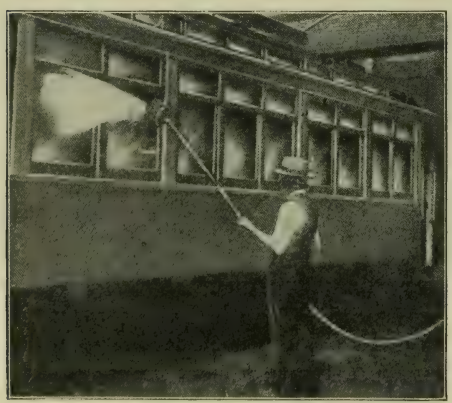


The "Baby" Auto

2½ horsepower, and the machine will travel 15 miles an hour. The 5-year-old operator with his little sister is seen in the cut, which we use by courtesy of the Motor News, Dublin.

METAL BRUSH FOR CAR WASHING.

A metal brush which fastens to a pipe or hose, and throws a stream of water while in use, is a recent improvement for



Washing Cars with a Metal Brush

washing cars. Wooden brushes swell and become worthless in a short time. The metal brush lasts much longer.

It is a big task to keep hundreds of car windows bright and any invention which saves time and labor in the work is always in demand by up-to-date railway companies.

ELECTRIC HEATED RUGS.

So many things are electric these days we have long since ceased to wonder at the constantly increasing list. The electric rug is the latest, or was a few days ago.

The rug is made with a warp of fine copper wire covered with asbestos, with filling of wool. It has the appearance of any other well-made tufted rug; it is made as carefully, in fact, more carefully, than most rugs, and when charged with an electric wire attached to the ordinary electric fixtures of a dwelling it generates heat very rapidly and at little expense—for the small sized rugs something like a cent an hour. Now, the practical value of such a rug lies in its use by the bedside or in the bathroom. The floor partially or entirely covered with a wire warp fabric which generates a continuous heat will, to a great degree, prevent the colds and the discomforts of the fall and spring time when the house is not always heated. A hardwood floor is at best a cheerless thing to step on in the chill dawn of the morning, or to kneel upon in the sad hours of the night. With a few rugs around a room all electrically heated, the early riser can perambulate without chilling his pedal extremities, and can indulge physical culture stunts as he leaps from rug to rug; there will be practical reasons, moreover, for the maiden's indulgence of that prehistoric habit of squatting "Injun-fashion" as she dons her shoes and stockings.

The rug can be set "warming" by connection to any electric light wall socket and turning on the current. There is no danger of setting the house afire, as the heat is mild and the under side of the rug protects the floor.

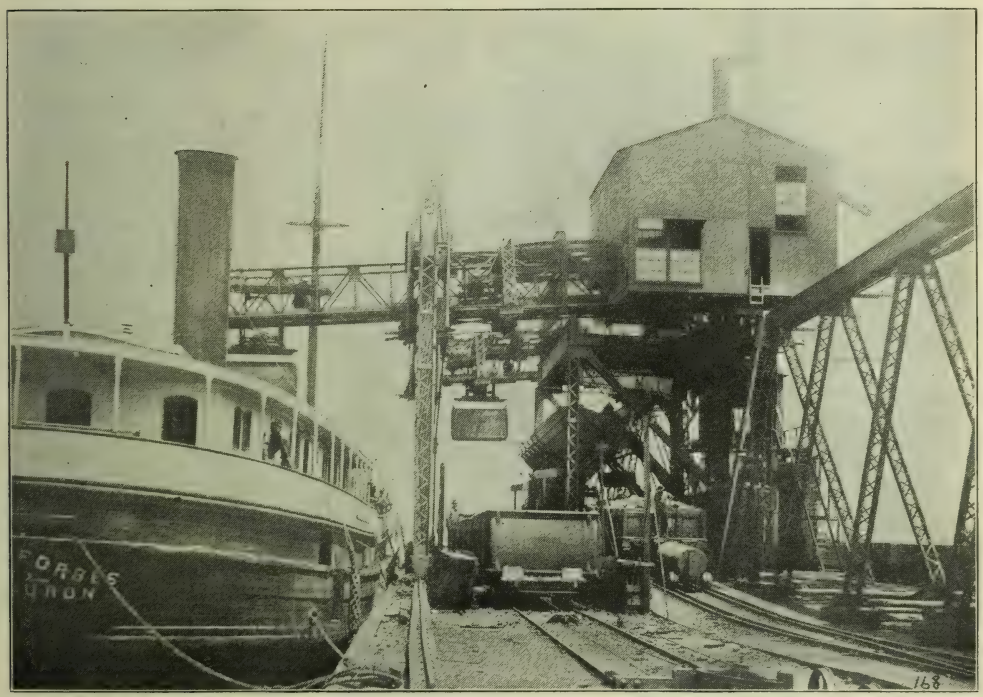
SAILORS ORDERED TO BLACK THEIR FACES.

One of the most curious orders given in the English navy is "All hands black faces!" And in order that this may be adequately fulfilled each of its warships carries among its stores a supply of such pigment as is used for the same purpose on the stage. This order is only given during the maneuvers, as a rule, for when a night surprise is intended it is not only the vessels that are made as little visible as possible, but the faces of the men must be blackened, for when powerful night glasses are used the showing of a white face is far more palpable than any landsman would suppose.

Some Remarkable Hoisting Machinery

How Coal and Ore are Handled at Important Lake Ports--Vast Amount of Work Done Almost Automatically

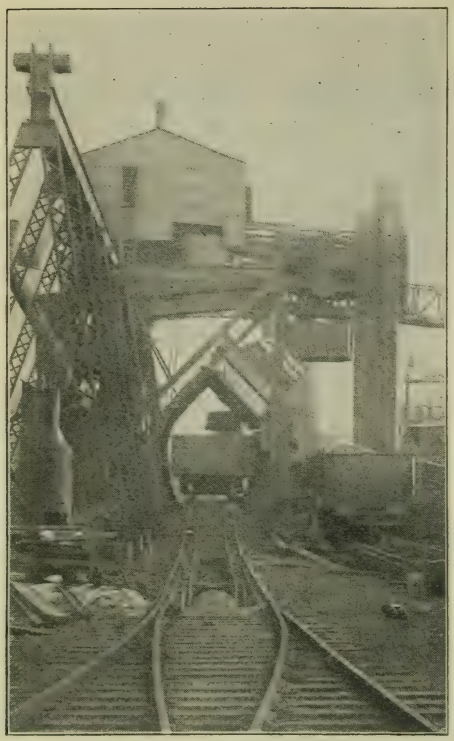
One hundred years have indeed wrought wonderful changes in the machinery and methods used in every line of industry. Twenty years have wrought startling changes! Up in Minnesota they tell a story of how twenty years ago the first carload of iron ore ever mined in that state was loaded at the Breitung mine and shipped to Two Harbors. The owner of the mines sent his son in 1883 to assume charge of the Iron Range railroad and the opening of the mines. The son, now United States Ambassador at the court of Berlin, promised that the first ore should be shipped August 1, 1884. He did it, but by a close shave. The huge Baldwin engine that drew the special train carrying Mr. Tower and a party of friends from Two Harbors to Tower, the scene of the event, scraped its paint against the rocks in the sides of the last rock cut on the way to the mines, and those who recall the event, declare they were barely able to get through, but the promise was redeemed.



The Conveyor Lifting a Tub--The Pusher Pushing a Car Into the Cradle

The party brought a carload of calico, beads, cheap jewelry, tobacco, pipes and fishing tackle for presents to the Indians, a large number of whom had been induced to be present by this means and the promise of plenty to eat. At sight of the plunging black monster with its escaping steam the red men fled precipitately to the woods and could not be prevailed upon to return for some time.

Everyone present helped to load that first car of ore. Some carried chunks of it to



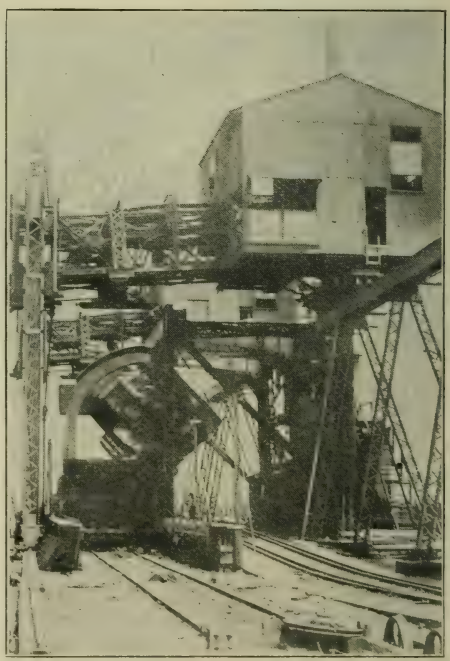
Position of Car in the Cradle--Pusher in the Center of Track Below the Level of the Rails so Next Car Can Pass Over It.

the car, while others wheeled a barrow full and no golden spike yet driven or ruddy wine splashed over a vessel's prow was ever the occasion of more merriment and felicitation. No Minnesota Indian could be frightened by a locomotive nowadays, and her carloads of iron ore only attract attention by their number and their value, but the incident shows what twenty years can do.

In this modern era, when mechanics are receiving more attention than ever before, an appliance may seem to be absolutely perfect for its purpose one day and on the next some great mechanical genius or expert may invent an appliance which will entirely do away with the old one, so great an improvement it is. Startling mechanical improvements are now wrought in a single day, ofttimes. Rarely is it the mechanical genius, with all his natural proclivities, who works these great changes. More often it is the expert—the man, mayhap, who has spent years in hard study and daily experience of labor, who is familiar with every mechanical principle and its application; who is blessed with no sudden inspiration, but who knows how to apply his knowledge, and by the study carried on in overalls and with greasy hands and by exercising a clear insight and reasoning powers, knows how to put two and two together. Such men class as experts and are employed by many large concerns simply to study the machinery employed and see where it is susceptible to improvement.

To trace many of the important developments in machinery would require several volumes. This article has to do only with some of the wonderful forms of hoisting machinery found at the principal lake ports in the Union for the purpose of loading and unloading ore and coal.

For handling coal from cars to vessels huge coal tipples are used in many places. The loaded car is first run into a cradle by means of a car pusher, a cylindrical affair having double-flanged wheels, traveling in the center of the track and drawn by means of a cable. When a car is in place in the cradle the pusher backs along its track and down a declivity in the center of the track

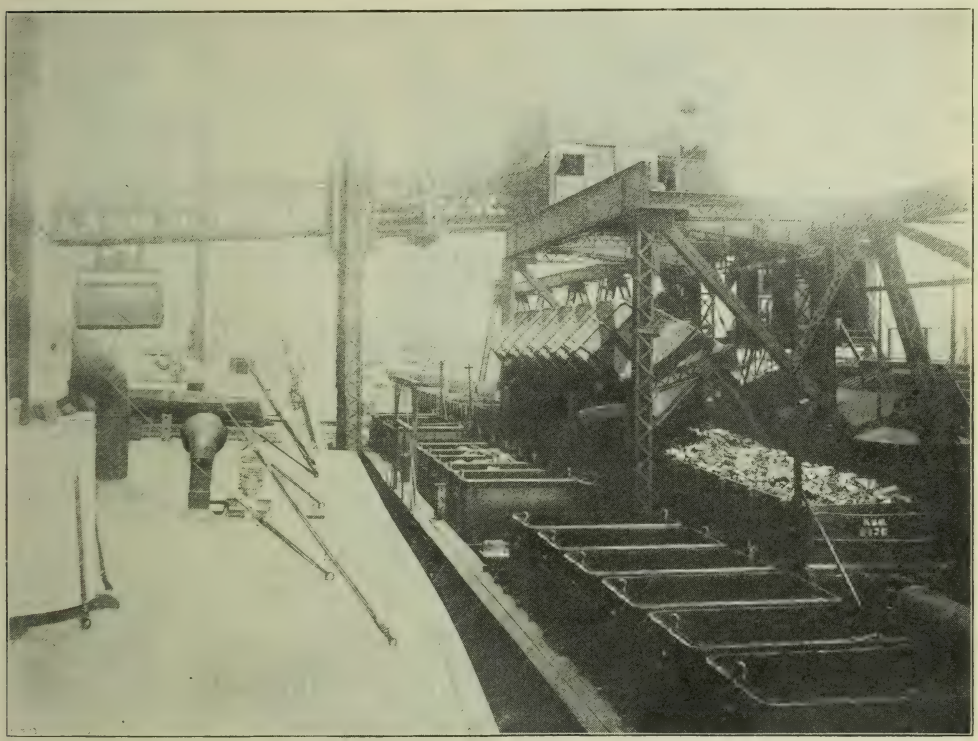


Cradle Turning Car Bodily Over so that the Coal is Dumped Through Chutes into Tubs.

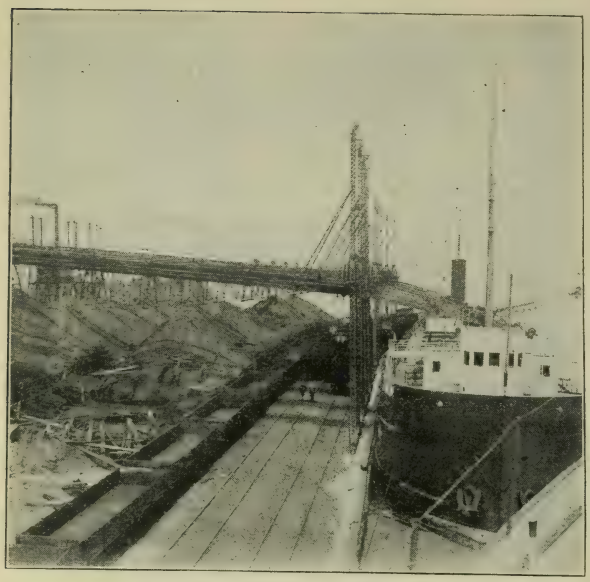
until its top is below the level of the rails on which the cars run. The next car then passes along the track and over the pusher which then travels behind that car in its turn and pushes it up the grade to the cradle.

The frame of the cradle on one side of the car rises around the car like a huge crooked arm and holds at a slant above and a little to one side of it a row of chutes or pockets. The car is securely clamped in place by hydraulic clamps and is then lifted and turned bodily over, the coal, as the car turns, rolling into the chutes or pockets above it. These chutes, when the car is in the inverted position open inside of special tubs, and the cradle when righting leaves the coal in the tubs ready to be lowered into the steamer's hold. The loading is performed by means of conveyors which pick up these tubs and lower them into the hold, the bottoms of the tubs opening when the tubs are in their lowest position in the hold. With this system there is practically no breakage, which is of great importance when handling bituminous coal. Three of these tipples with conveyors have loaded easily 25,000 tons of coal in 22 working hours.

Of all the ore handled at the various lake ports last year, 90 per cent was unloaded by what is known as the "Brownhoist Bridge Tramway." This consists of a series of bridges built up along the docks, each bridge resting on a front and rear pier and each operating independently of the others. The span between the two supports is usually about 180 feet and underneath it the space is used for storing coal or ore, as the case may be, with room for tracks next to the front pier. Beyond the back pier of each bridge is a cantilever extension 92 feet in length, and at the front, extending over the boat to be unloaded, is hinged to the bridge proper an apron which is capable of being raised as the boat enters or leaves the dock.



Position of Tubs Beneath Chutes--Pusher Behind Loaded Car--One Tub Being Lowered by Conveyor into the Hold of a Vessel



Span of the Brownhoist Bridge Tramway, Showing Stores of Coal and Ore and Empty Cars Beneath

The operation of each bridge is controlled by one man and operates with either steam or electric power. The bucket which is thrust down into the hold of the vessel for its load is carried by trolley and the load can be dumped at any point desired. Sometimes the material is loaded direct into cars at the cantilever end. The bridge travels along the dock front so that it is not necessary to move the boat after it is once tied to the dock.

In this manner coal and ore amounting up to thousands of tons are handled quickly and cheaply and what once would have required a week's labor by many men can now be done in a day by the aid of a few.

How remarkable the extent to which power—steam and electricity—have taken the place of human toil! What are those who delve in earth and rock? That vast throng that daily troops into the subterranean passages that honeycomb the interior of this bounteous country and by the lurid flare of lamps ply pick and shovel against want and famine and cold? This gigantic, ingenious device, this child of a cunning mind, operated by this wonderful force, handles their entire output, which they toiled over with sweating brows and aching limbs; handles it without a groan, without a mishap, without a delay; every operation accurately timed.

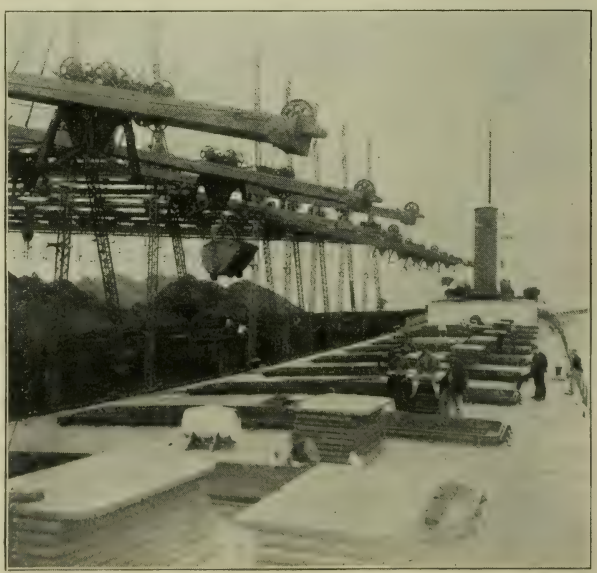
Perhaps the millennium will come when ingenious man has made every operation incidental to human existence automatic, and there is nothing left for him to work at or to contrive.

ARTIFICIAL GUTTA-PERCHA.

The demand for gutta-percha is so prone to exceed the supply that manufacturers are continually seeking a substitute for it. It is used for submarine cables, and for golf balls. In constructing cables it is used to insulate the conducting wire from the exterior metal sheath.

The German telegraph department has been testing some cables in which an artificial gutta-percha consisting of a mixture of india rubber and palm wax, the melting point of which is the same as of rubber, was used.

The cost of the artifical gutta-percha cable is about 35 per cent less than the ordinary cable, and its electrical properties are equal to those of the real thing.



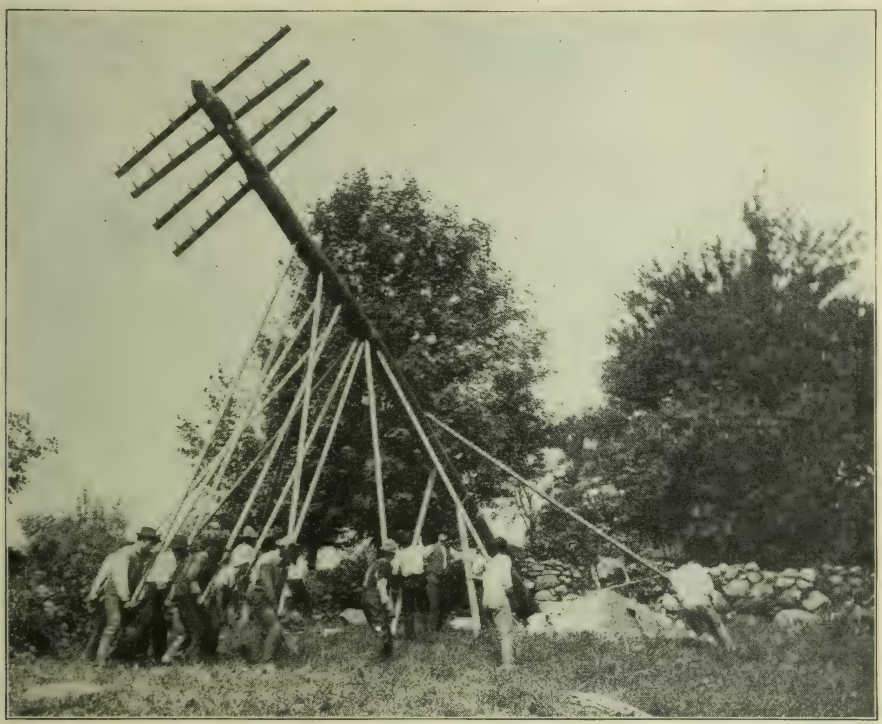
Aprons of Brownhoist Bridge Tramway Extending Over Vessel--Bucket on One Apron

How Telephone Poles Are Set

Four Men in Two Minutes Now Do What Formerly Required Twenty Men

The modern method of setting telephone poles is in striking contrast with the old method. Telephone builders were many years in finding a method of pole-setting which was neither slow nor expensive.

Several years ago the only recognized way to set a pole was by "piking"—that is, by lifting up the pole and then lifting it into place with long pike-poles, supporting it with a yoke when necessary to secure a new hold with the poles. This was hard labor for twenty-odd men and it was slow work. Of course it was realized that if a machine could be employed it would be a great saving in men, time and money. Several mechanical pole-setters of different design were constructed, none of which met with success. Finally the foreman of a construction gang invented a machine called a pole-derrick which satisfactorily filled the long-felt want in every particular, and was so simple in operation that designers felt ashamed that they had not thought of it themselves.



"Several Years Ago the Only Way to Set a Pole was by Piking"

Mounted on a strong heavy wagon with one leg over each pair of wheels is an inverted V about 28 feet high. Rigged to the peak of this is a duplicate block and tackle, the one of steel and the other of 1½-inch rope. On the bed of the wagon is another block which forms the combination with the upper one and through which the rope, to which the horses are hitched, passes. The same team which pulls the wagon does the hoisting. The derrick goes into action in a very interesting and effective way. As soon as a pole is set the horses are hitched to the wagon and it is moved on to the next pole. Often this moving is a very ticklish business. The country is

more often rough than smooth, and the four men who comprise the derrick gang have to be very careful in guying the swaying machine as it travels. Once arrived at the hole the derrick legs are leaned to the proper pitch and strongly guyed to nearby trees or rocks. Then a logging chain is passed about the pole at a place well above the balance point. While this is being done the horses are attached to the pull rope. The pole is then shifted until the cross arms may be put on. As soon as these are bolted and spiked the

"From the Time the Pole Leaves the Ground to the Moment It is Set is No More Than Two Minutes."

foreman gives the word, the horses start in a steady even pull and the pole rises. In less than a minute it swings clear. The men guide the butt so that it is over the hole and the horses back. The pole drops into place and is ready for the filling gang, who straighten it up and pack down the earth and rocks to hold it. From the time the pole leaves the ground to the moment it is set is seldom more than two minutes, affording a decided contrast with the time required to place it in the old-fashioned, man-handled way.

One of these derricks was used in constructing a 60-wire line between New York and Boston, and it was found that this method of setting poles cost $20 less per day than the old way.

BUTTER GLAZED TO KEEP IT FRESH.

Nearly all the butter sold in forms in both England and Germany is glazed with a thin glass-like coating of sugar, says Consul-General Guenther, of Frankfort, Germany. The butter is first carefully kneaded and washed and then moulded in 1-pound forms and placed in a cool room. A hot sugar solution is painted over the surface to effect the glazing. A very soft brush is used and the painting done very rapidly. The hot solution melts the surface of the butter, and the sugar and melted butter form a varnish which keeps the butter pure and fresh and protects it from all deteriorating outside influences.

THAWING THIRD RAILS.

A system of thawing sleet and ice from third rail electric lines has been tested at Bridgeport, Conn. A steel wire is carried under the head of the rail and insulated from it. The temperature of the rail was raised from 15 deg. F. to 34 deg. F. in 15 minutes.

Taking subscriptions for Popular Mechanics is not only pleasant work but pays big commissions. Write for full particulars.

HOW TO SECURE A LIGHT WITHOUT MATCHES.

Touring automobilists may sometimes find themselves without matches and requiring light. In such case it is well to know how to secure a light without matches. The Automobile tells how it may be done.

If the car is fitted with jump spark ignition, disconnect one of the high tension wires from its plug; place the free end of this wire in such a position that it lays about a quarter of an inch away from the cylinder casting. Saturate a small piece of cotton waste or a piece of paper with gasoline and place over the free end of the ignition wire. Turn on the ignition switch and crank the motor. When the spark jumps from the free end of the disconnected wire to the cylinder casting, it will set the paper or waste on fire.

Be careful not to allow the blazing waste or paper to fall into the "apron," underneath the motor, if one is used. This "apron" is usually covered with grease and oil, and if it catches fire it may imperil the car.

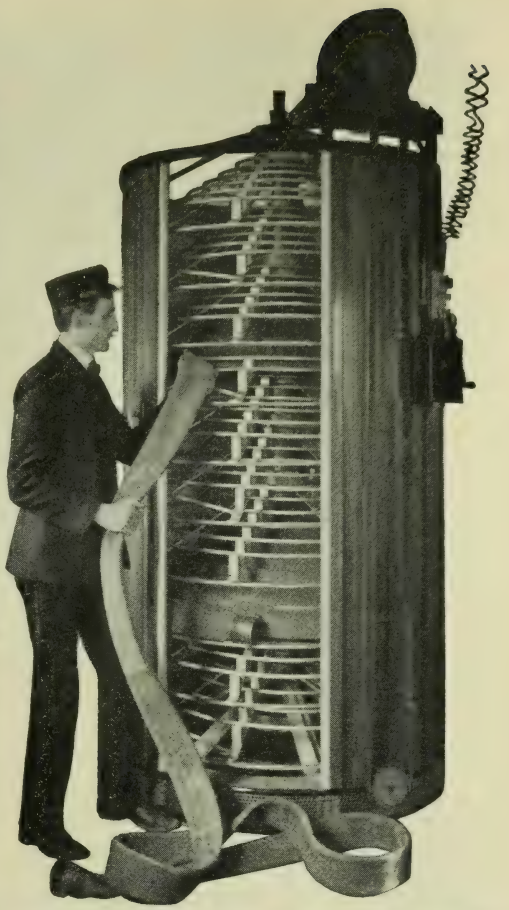
On machines having make and break ignition one wire should be disconnected from the insulated electrode in the cylinder. A piece of waste or paper saturated with gasoline, as previously described, is then laid on the cylinder head. The motor is next started and allowed to run slowly—on three cylinders. If the wire which has been disconnected from the sparker, as described, is now touched on and then removed from the cylinder casting or masse close to the waste, the spark resulting from the short circuit will ignite the waste or paper.

DRYING FIRE HOSE BY ELECTRICITY.

Does Away with the Old Hose Tower or Hose Rack in Engine Houses.

Rotary fire hose driers run by an electric motor are now coming into use in up-to-date engine houses for drying hose. Formerly the hose was carried up into the tower, built in the engine house for the purpose, and there hung up to dry. The job of hanging it up and taking it down again was by no means a small one, but the task was not only hard on the firemen but was also a strain on the hose, which is an expensive item in the station's equipment.

The rotary fire hose drier winds and unwinds the hose automatically and with less friction than in ordinary handling of it.



Rotary Fire Hose Drier Automatically Taking in Hose.

The exterior of the drier is constructed of hard wood and the interior is of iron, steel and brass. The electric motor is placed wherever most convenient, on top being a good place. The coils of the hose, when wound on the cylindrical racks, do not come in contact at any point.

The drier is closed and as easily as you turn on an electric light, so easily is the machine started. Its rapid rotation gives it one means of drying, and at the bottom of the cylinder a large fan rapidly revolving draws over the hose about 6,000 feet of air a minute. This carries off all the moisture and in a few hours the hose is perfectly dry, without having been subjected to any strain.

The drier occupies four square feet of floor space. Its speed can be regulated at will and one man can operate it, handling 500 feet of hose at one charge.

"The Auto Drew the Car Along at Its Usual Speed."

AUTOMOBILE DRAWS STREET CAR.

The owner of an auto in Detroit was boasting about the pulling abilities of his machine, and to make good his claims hitched on to a street car that was crowded with passengers. The auto turned out to be a first-class locomotive and drew the car along at its usual rate of speed. The illustration is used by courtesy of the Motor Age.

FIVE HUNDRED DOLLARS POPULAR PRICE FOR AUTOMOBILES.

Where there is one person who can afford to pay $5,000 for a luxurious automobile there are fifty who cannot pay more than $500, and these are waiting for the manufacturers to bring their prices down. Thus far the demand for high-priced machines has been sufficient to keep the factories busy on machines ranging from $700 up, but if autos drive horses from the streets it will be when present prices are very greatly reduced.

That $500 is a popular price was demonstrated a few days ago in this city. A dealer had a job lot to dispose of, and advertised them at the usual price, $750. No sales resulting, he tried them at $700, then $600, but without satisfactory results. Then he came out with an offer to close them out at an even $500 each, and they were sold in no time.

The masses want a safe, strong car, reasonably fast, and plain and simple in finish, and with the least possible number of contraptions. Before many years such machines will be available and will find ready buyers.

CARD DISPLAY DEVICE FOR TELEPHONES.

A new telephone adjunct is a holder for cards bearing the names and telephone numbers and exchanges of firms and business houses with which frequent communication is held. The cards, indexed in large red letters, radiate from the center of the holder and may be rapidly rotated until the desired name appears; a deflector holds them in position for ready reference. The device saves much time spent in looking up the same numbers again and again in the directory.

A Handy Telephone Attachment.

British Iron Shipentine "California," the Last Sailing Ship Owned by the White Star Line, of Liverpool

HOW CORN COB MEAL IS MADE.

Cob meal is used for stock food, but its manufacture has been regarded as a secret, and few people, even millers, know how it is made. An inspector for an insurance company gives the following account of the process:

Cobs are conveyed from cob warehouse by belting to the grinding and cleaning department, where they pass through separator, and all foreign material is removed and carried away. During this process all husks and chaff are removed by blower fan and passed to ironclad house on outside through metal pipe. This light stuff is later baled and shipped as material for mattresses.

The cobs are next conveyed by screw conveyor in metal trough to mill room, where they are elevated to third floor and passed to rolls through tin-lined spouting. During the milling process all pith and bee wings are removed by blower fans, conveyed to metal screw trough, where the heavier material drops to bottom and lighter is blown out to dust house. The heavier unsalable stuff is brought to boiler house and used for fuel. The only part of the cob used is the hard inner core, which is reduced to meal in the mill room, whence it goes to the large bins in the warehouse and packing room.

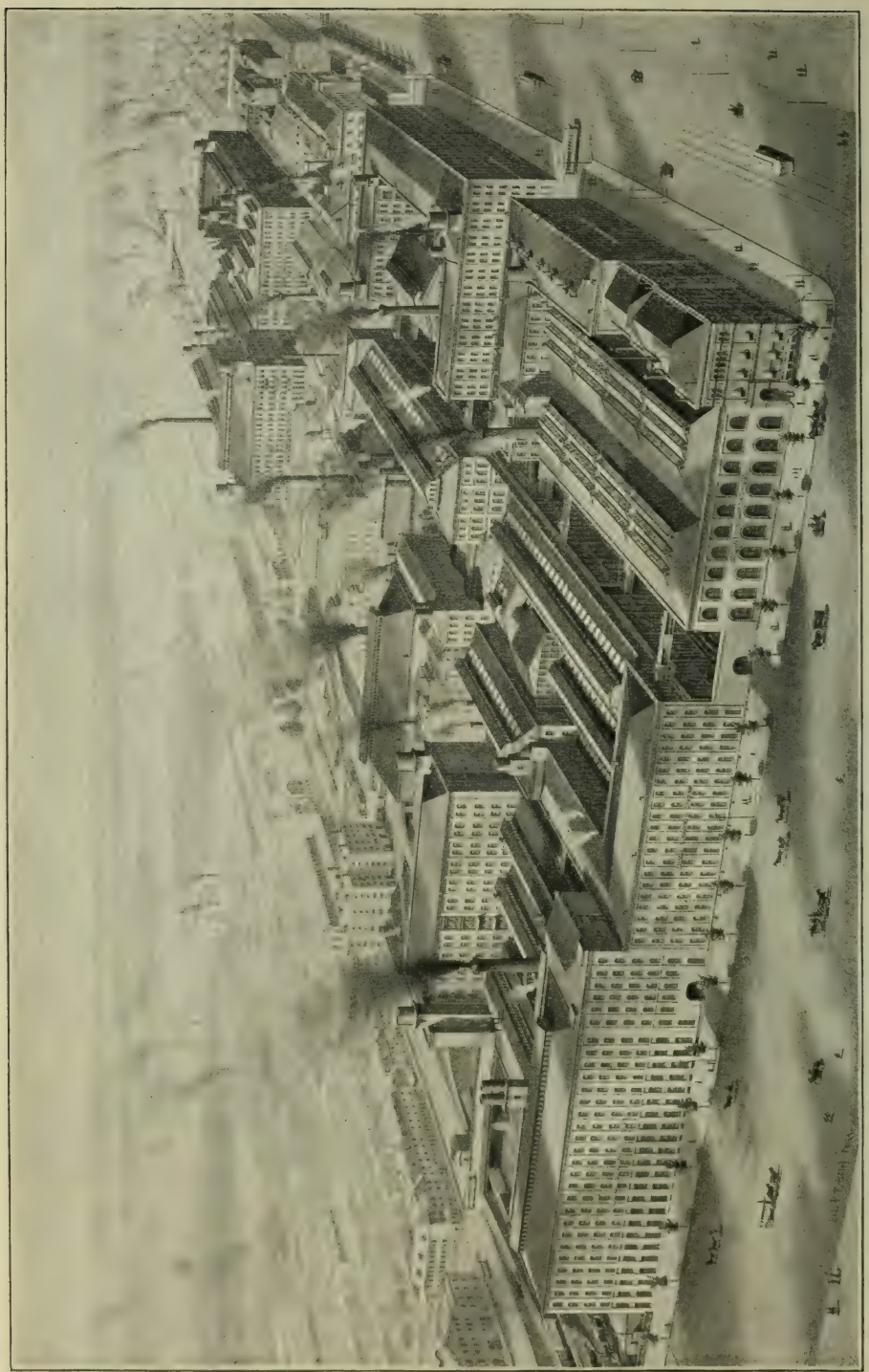
DIVING IN A MINE.

Nervy Work in Absolute Darkness

To don a diver's suit and plunge into water under the most favorable circumstances requires pluck and a fearless will, but when the water is 50 feet deep and at the bottom of a mine 1,100 feet below the surface the conditions are by no means improved. Such a feat, however, was recently performed in a deep mine in the far West.

An accident had happened to the big pump. The divers descended in absolute darkness, and made certain repairs by sense of touch and feeling that were necessary to start the pump, and it has been running since perfectly. The cost did not exceed $175, whereas, if a new pump had been purchased and put down it would have cost at least five times the expense incurred for the divers. It was a very unusual procedure, but a very successful one.

Large gongs placed on poles at important street corners are used by the Columbus Railway & Light Company to notify inspectors of breakdowns on any division of the line. The gongs are rung from the main office and the inspector communicates with the office by means of a telephone on the same pole as the gong, and is instructed where to go and what to do.



The Baldwin Locomotive Works--Philadelphia

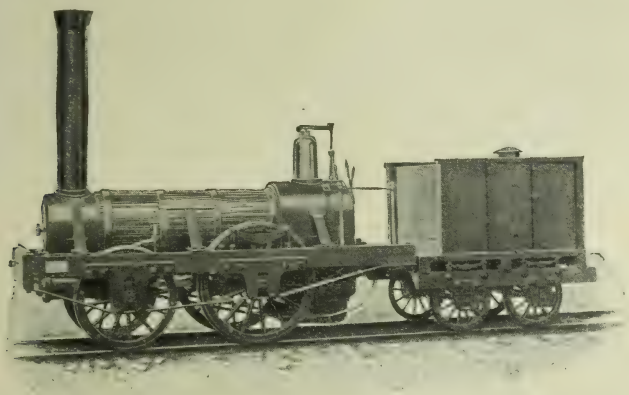
Baldwin Builds Six Locomotives a Day

Story of a Great American Industry -- Employs 15,800 Men -- Covers 37 Acres

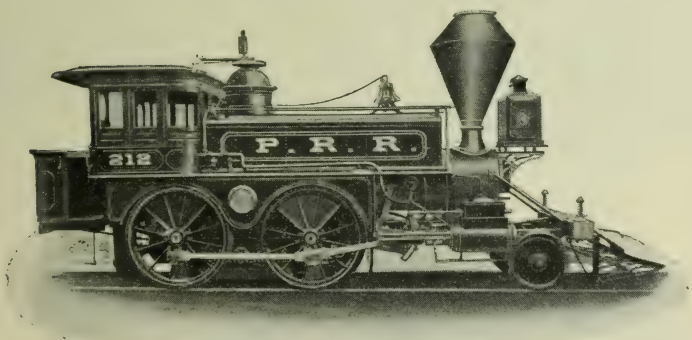
The Baldwin Locomotive Works, Philadelphia, was founded by Matthias W. Baldwin, when in 1832 he built the "Old Ironsides." A whole year was spent in its construction, and $3,500 was the purchase price. It went into service on November 23 on the Philadelphia, Germantown & Norristown R. R., which was operating 6 miles by means of horses. "Old Ironsides" was a great event, weighing all of 5 tons, with driving wheels 54 inches in diameter and front wheels 45 inches, the wheels having wooden spokes and rims and wrought-iron tires. Her cylinders were 9½-inch diameter with 18-inch stroke; the boiler was 30 inches in diameter and 7 feet long. Great difficulties were encountered in building this first locomotive owing to a lack of necessary tools. However, she did good service for a number of years, and is now honored and cherished far above the successors of recent days.

Thirty years passed, during which great improvements and inventions had worked many changes in locomotive building, and Baldwin pointed proudly to locomotive No. 1,000. It was built for the Pennsylvania railroad and had two pair of driving wheels. It was intended for light passenger work, and dispensed with a tender by carrying its water in a tank over the boiler. This machine weighed 23 tons.

The next 10 years were busy ones, during

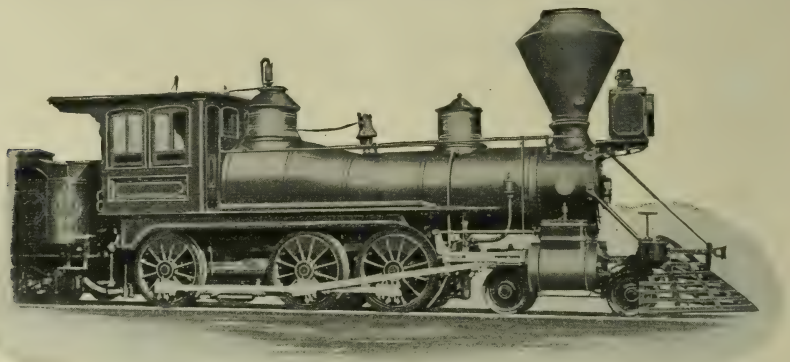


The First Locomotive, "Old Ironsides." 1832

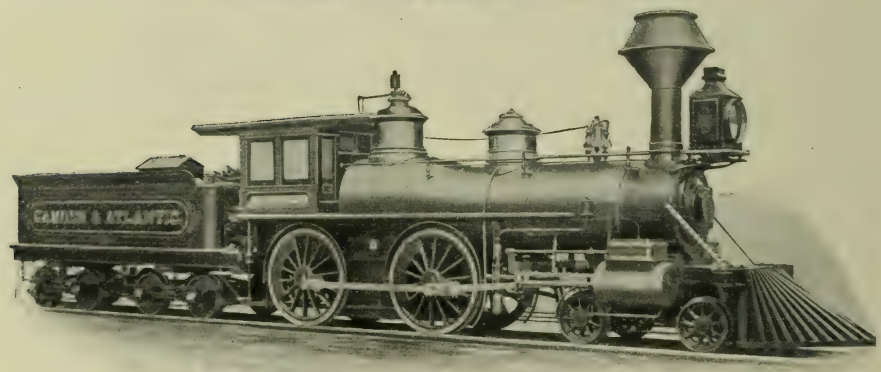


The 1,000th Locomotive, 1861

which a thousand locomotives were built, No. 2,000 being completed October 30, 1869. It shows a much greater likeness to present day types and was delivered to the Pennsylvania road. This was a soft coal burner, weighing 75,600 pounds, with 56,000 pounds on the driving wheels. The separate 8-wheel tender had a capacity of 2,400 gallons of water and 4½ tons of coal. Two hundred and fifty of these were built, and it happened that No. 3,000, which was finished in December, 1872, was of the same type



The 2,000th Locomotive, 1869

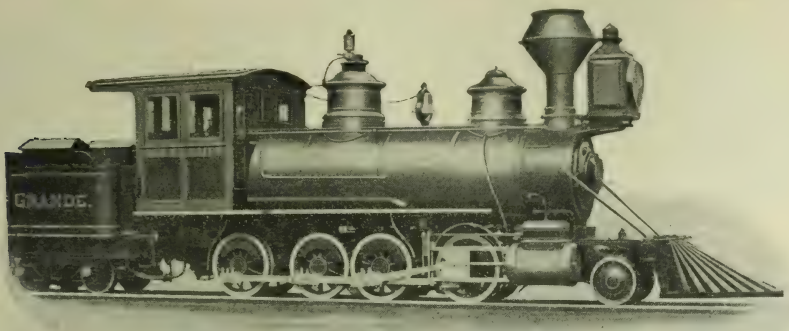


The 4,000th Locomotive, 1876

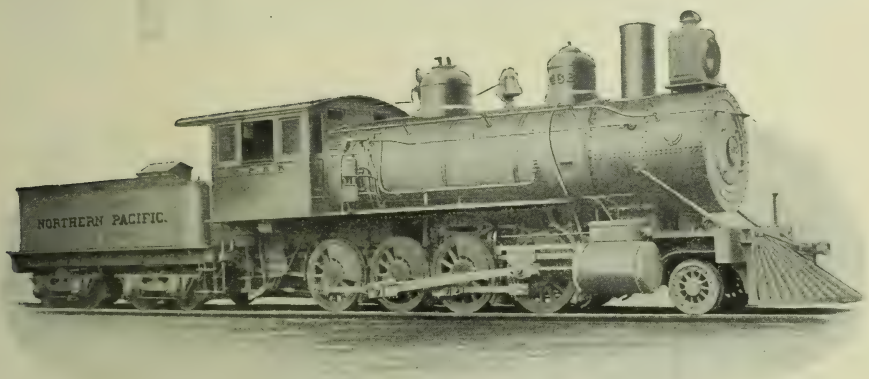
The 5,000th Locomotive, 1880

and size. No. 4,000, October, 1876, was considered handsome in those days. It weighed 35 tons, and shows the change in stack, but retains the low cab.

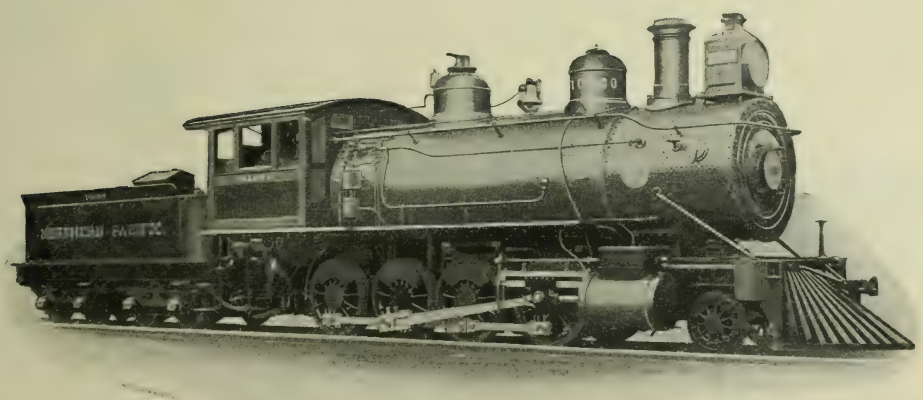
No. 5,000 was an effort toward greater speed, which the better tracks permitted and growing business interests demanded. It came out in March, 1880, and covered the



The 6,000th Locomotive, 1882



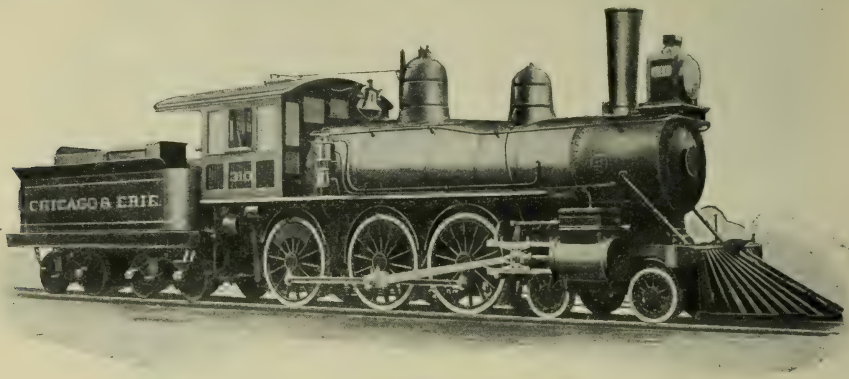
The 7,000th Locomotive, 1883



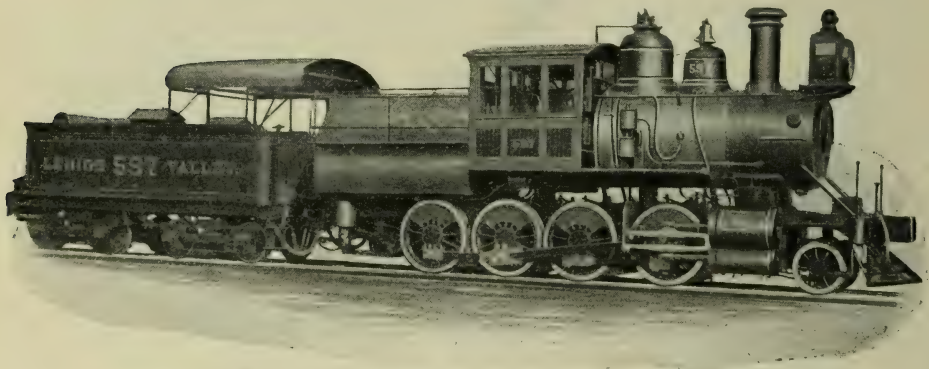
The 10,000th Locomotive, 1889

distance between Philadelphia and Jersey City in 90 minutes. It was afterward sold to an air brake company and sent to England to demonstrate the brake. The evolution of the stack is noticeable and a more roomy cab, which begins to approach in height that of the stack. The firebox is larger and the one pair of drivers were 78 inches in diameter. The entire weight was 83,200 pounds, with 38,300 pounds on the driving wheels. An auxiliary fulcrum was brought into play by means of a toggle joint operated by a steam cylinder which shifted 9,000 pounds more on the drivers when desired.

Locomotive No. 6,000 was built in January, 1882, and was one of the heaviest in use at that time on the narrow-gage roads. One hundred of this type were sent to the Denver & Rio Grande road. In working

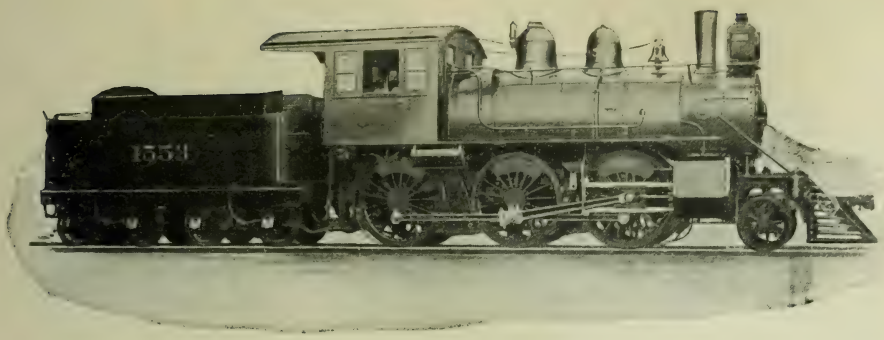


The 12,000th Locomotive, 1891



The 13,000th Locomotive, 1892

The 16,000th Locomotive, 1898



The 17,000th Locomotive, 1899

order the weight was 58,000 pounds, of which 50,000 pounds were on the drivers.

The capacity of the works had been increasing by the erection of additional buildings and the invention of labor-saving machinery, and in less than a year the output had reached the 7,000 mark. This locomotive weighed 110,000 pounds and went to the Northern Pacific road.

No. 13,000, which appeared in 1892, was then a new type, with the engineer's cab forward over the boiler. It weighed 141,600 pounds, had Vauclain compound cylinders and went into freight service on the Lehigh Valley road.

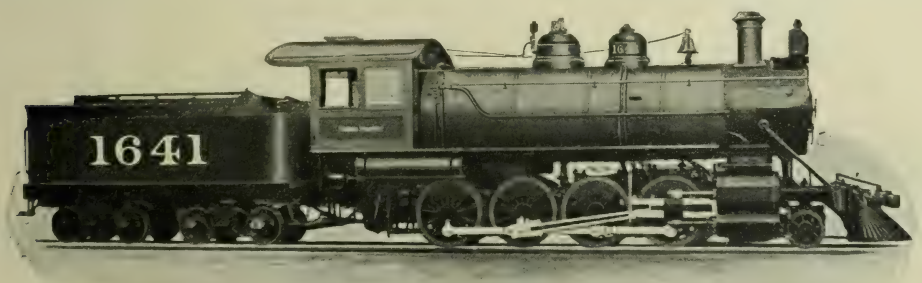
No. 16,000 is peculiar in appearance and interesting as having been built for the Moscow-Windau-Robinsk railway of Russia. Twenty engines were sent over at this time. No. 17,000 is a freight engine for the Chicago, Burlington & Quincy, and 18,000 was taken by the Union Pacific. No. 19,000, built in 1901, is a mammoth freight locomotive for the Illinois Central. No. 23,000 was turned out in October, 1903, and is known as the Santa Fe type, having a peculiar construction of the cylinders. No. 24,000, March, 1904, also went to the Santa Fe.

The progress made in 72 years from the little 9-inch cylinder of "Old Ironsides" to the Vauclain tandem compound system can be realized best by a study of the illustration, in which a portion of the walls surrounding one set of cylinders is removed to show the construction and operation of the valves. The picture was made from a model of actual size and is best realized by comparison with the height of the man standing beside it.

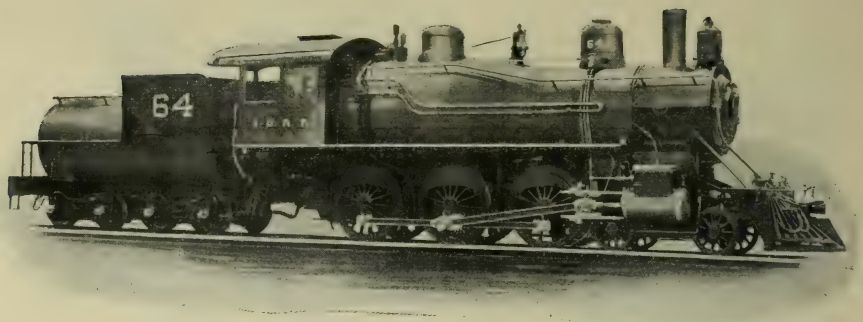
The locomotives illustrated in this story are all on exhibit at the Exposition in St. Louis, many having been loaned by railroads for the purpose, to be returned when the Fair closes; the others are the property of the Baldwin company.

This brief pictorial history of the progress of locomotive construction represents the extension and expansion of the great railway system, which has reached out in all directions until it covers the land from ocean to ocean and Great Lakes to the Gulf. The Baldwin works has kept pace and is now one of the great industries of the country.

The annual capacity of the works is at present 2,000 locomotives per year, with



The 18,000th Locomotive, 1900



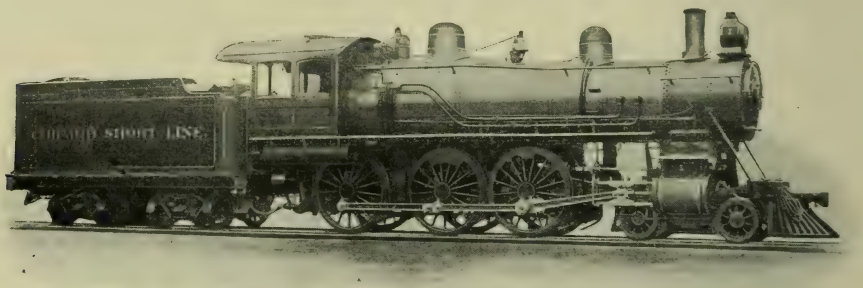
The 19,000th Locomotive, 1901

repair parts produced equal to 250 locomotives more. Work is carried on at the rate of over six complete locomotives each day. There are 39 buildings covering 17 acres of ground, with 37 acres of floor space, where 15,800 men are employed. The principal departments run continuously 23 hours a day. To drive the thousands of machines 11,334 horsepower is required. The works are lighted by 5,550 arc and incandescent lamps; 2,150 tons of coal are burned each week, and 5,000 tons of metal are used every six days—almost a thousand tons a day.

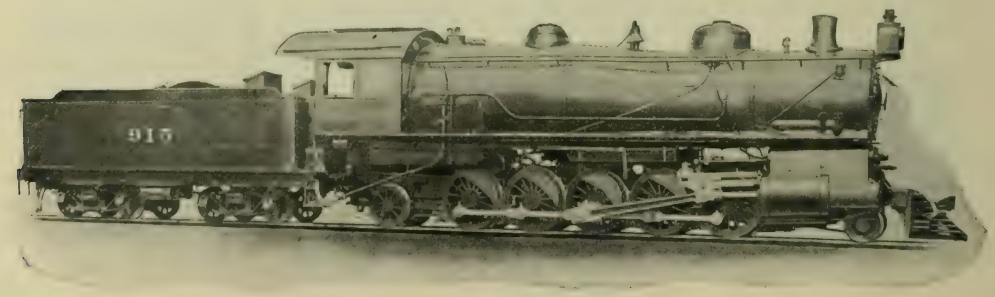
Matthias Baldwin builded better than he knew.

AMERICAN HORSESHOES FOR ENGLAND.

Tons of American horseshoes are sent to England every day, and the strange feature of the case is that they are made chiefly of English iron. The American Machinist says: In Poughkeepsie, N. Y., is an establishment in which many tons of horseshoes are made daily. Many of these go to England and are there nailed to the feet of omnibus and other horses working in London. A very large share of the scrap iron from which these shoes are made comes from England. Scrap iron is considered the best material for horseshoes, and it is not so plentiful as it once was.



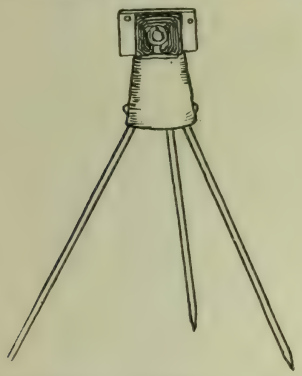
The 20,000th Locomotive, 1902



The 23,000th Locomotive 1903

A HOME-MADE CAMERA TRIPOD.

For amateur photography it is wholly unnecessary to purchase a camera tripod, as a very satisfactory one can be made at home.

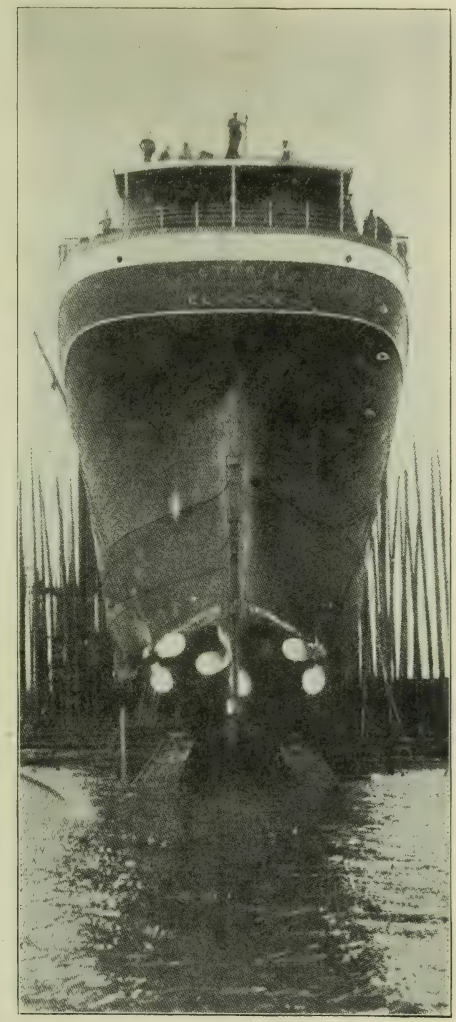


For legs select three 1x1-inch sticks 4 feet long and sharpen them at one end. Place the pointed ends of the legs downward and at points forming a triangle on the floor. Cover the upper ends with a lard pail placed upside down as shown in the sketch. Adjust the pail so that it is level and steady and the tripod is ready for use.

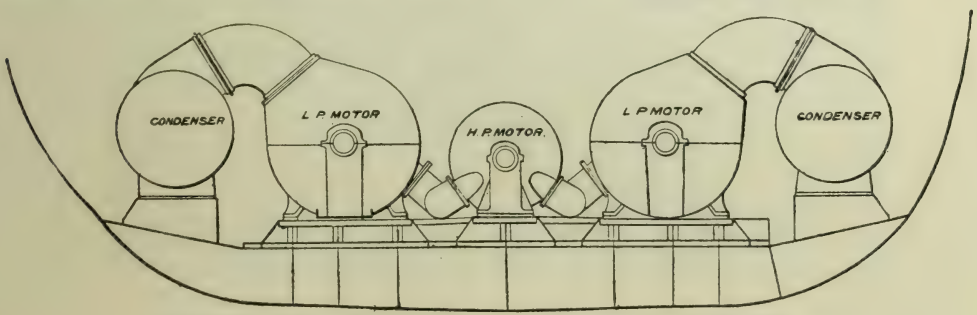
THE TURBINE LINER "VICTORIAN."

The launching, a few weeks ago at Belfast, of the first Atlantic turbine liner is considered in marine circles to mark the beginning of a new era in ocean-going vessels. The illustration is a cross section looking forward and shows the arrangement of the two condensers, the two low pressure and the high pressure turbine. The turbines, which are of the Parson's type, are the largest yet built.

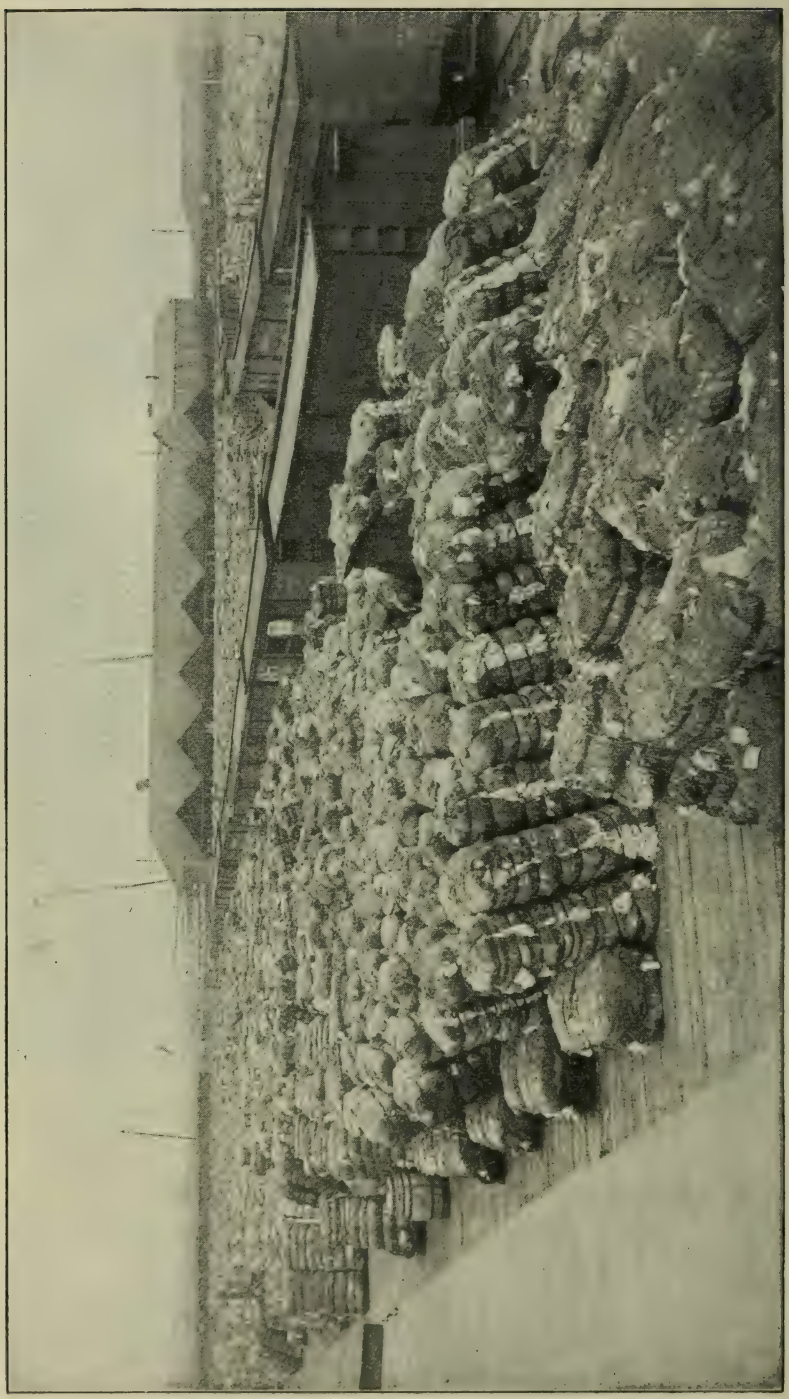
The "Victorian" is 540 feet long; breadth 60 feet; depth, 42 feet 6 inches, with a displacement of 13,000 tons. She is divided by bulkheads into 11 compartments which with the double bottom allow the vessel to have 20 distinct water-tight spaces. The Marconi system will be installed, and a refrigerating plant for the carriage of perishable freight. The vessel has accommodations for 1,300 passengers, and can carry 8,000 tons of freight.



Ready to Launch



Cross Section Showing Arrangement of Turbines



"Thousands of Bales are Exported from this Place Every Year." Cotton Wharves at Savannah, Ga.

Courtesy "Dixie," Atlanta, Ga.

Gathering the Cotton Crop

The first frosts have reached the cotton belt and already the bolls are bursting and opening their treasures. Cotton picking is a busy time in the South, and for the next few weeks the pickers by thousands will be gathering, the gins will be piling up the white stacks, and the balers, and teamsters, the steamboats and railroads will be rushed to their full capacity.

Already on the long wharves at the great export centers of the South lies heaped millions of dollars of the wealth of these United States. Not, to be sure, in glistening heaps of coins or bundles of bills, but in that substantial form which represents a rich and productive soil and healthful, soul-developing human toil.

Savannah, Ga., is one of these representative business centers of the South. Located as it is on the Savannah river where vessels of 14 feet draught and upward discharge, and load three miles below the harbor, and defended by Forts Pulaski and Jackson, its great wharves are scenes of teeming industry. Rice, cotton, lumber and many other important products are brought thither to be loaded on great vessels and carried to other ports. Of cotton alone hundreds of thousands of bales are exported from this place every year and the sum total of Savannah's exportation amounts to many millions of dollars each year. A vast space on the wharves is given up to naval stores.

Courtesy "Dixie," Atlanta, Ga

Naval Stores and Lumber Docks at Savannah, Ga.

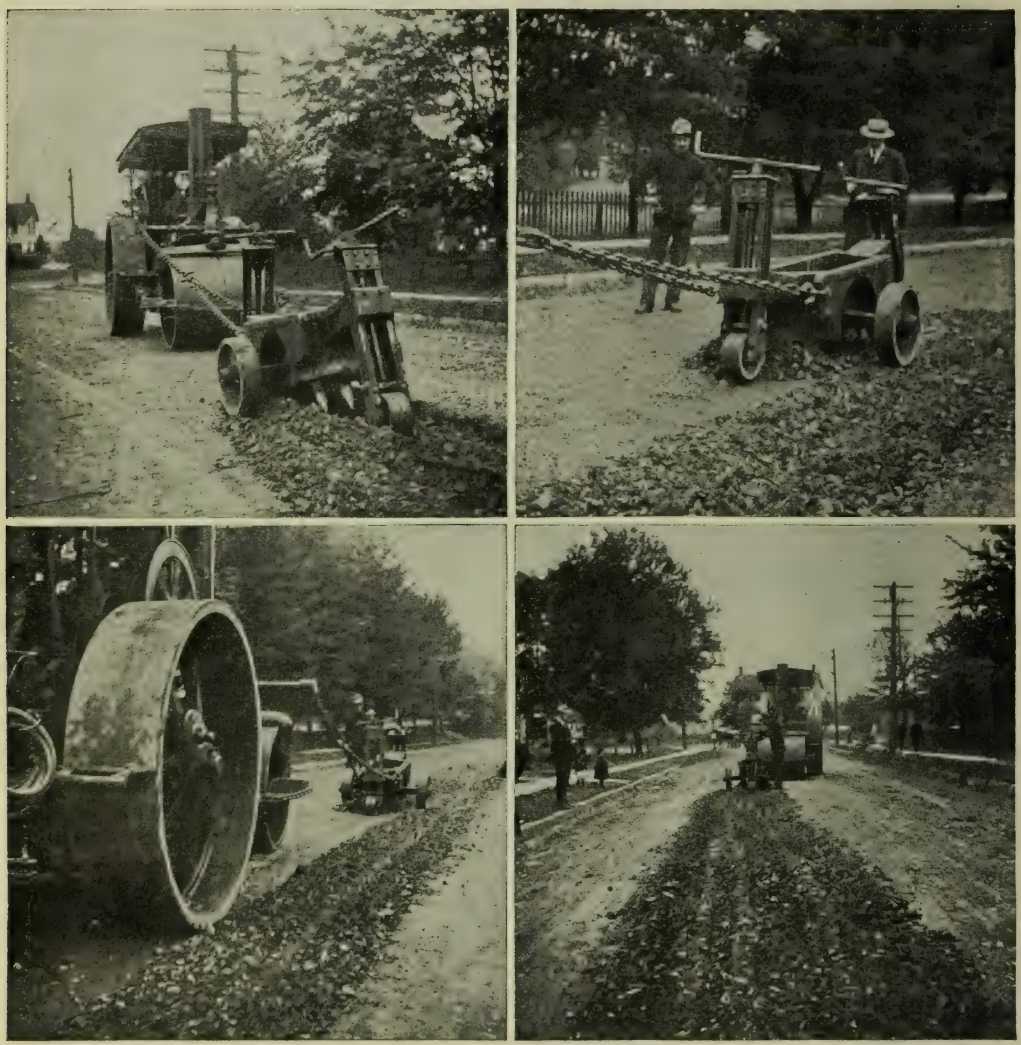
AMERICAN COASTS PROTECTED BY ELECTRICITY.

Nowhere is the revolutionary change that electricity has wrought more marked than in the extent to which it has been put to use in our coast fortifications. No part of the equipment of the fortress is more important, now that the electric installation involves so many features.

Electric fans, electrically-operated ammunition hoists, telephones by which the whole system of fortifications, the commandants and subordinates are put into communication, electric searchlights, telegraphs, submarine mines electrically controlled, electric signaling lights, electric lights, electric clock circuits, all are in use, and in time, probably, among these will be numbered wireless telegraphy.

The "Porcupine," A New Machine For Repairing Macadam Roads

A new machine for repairing macadam roads called the Porcupine is attracting considerable attention from municipalities where the expense for road repairs amounts to a considerable sum annually. The machine is quite as ungainly in appearance as the animal after which it is named, but like that animal it has quills or spikes which do the work most effectively.



Four Views of the Porcupine in Position

The Porcupine takes the place of the old, unsatisfactory and expensive method of hand picking the roads and breaks up the surface of the hardest macadam road from curb to curb, uniformly loosens and separates the particles that compose the surface, but without breaking the pieces of crushed stone and to a depth which removes all ruts and permits of reforming the street.

The machine weighs 4,000 pounds and, in the process of scarifying the road, is drawn by an eight or ten-ton steam roller to which it can be attached in a moment's time by means of a chain, and quite as easily

detached. The steam roller drawn the Porcupine to the end of the length of street under repair, one man regulating its operations. It does not jump or switch from side to side, but follows its course straight and true. If there are crossings to pass over its spikes are lifted until it has passed. When it has reached the end of the piece the roller laps over and draws the Porcupine back again, the machine scarifying each time for its full width and to any depth desired, the depth being regulated while the machine is in operation.

After the scarifying process the road can be harrowed to form a crown, if desired, rolled down, stone and dust added as a top dressing and then sprinkled, making a fine new street, perfect in every way and repaired at a minimum of expense.

One Porcupine with the aid of one steam roller has scarified a block of the hardest city street to be found, and the surface was then shaped up and rolled down, the whole process being done, by the labor of four men, between the hours of 10 a. m. and 6 p. m. This is a fair example of the amount it can do. In other terms it may be stated as able to thoroughly loosen 4,000 square yards in ten hours. The machine will work close up to the curb and while moving in either direction.

The Porcupine in Position

THE MAN BEHIND THE SHOVEL.

The way in which the man who shovels the coal into the furnace does his work has the effect of increasing or decreasing the cost of steam production, although it is hard to get mill owners to realize this fact.

Modern Machinery tells of a recent test which shows how different firemen working under the same conditions will produce different results. Four good stokers were put to fire the same boilers, all conditions being similar. There was a difference between the most and least expert of 23 per cent in capacity and 18 per cent in economy.

The raw material that passes through the hands of the fireman is one from which there is no by-product. As a rule, he does his best and maintains a fairly even steam pressure. He knows that the less coal he throws in the lighter is his labor, but beyond this he has no incentive to economy. Yet he is the one who can effect economies. Some of the larger plants have introduced a coal bonus, which is divided among the firemen who show best results. This plan might not be feasible in small plants where only one or two men are employed, but in such cases the manager can interest himself to the extent of seeing that coal is used intelligently.

STUPENDOUS PROJECT OF BRITISH SCIENTISTS.

Plan to Dig a Hole Twelve Miles Deep—To Cost $25,000,000—Time Required 85 Years.

The British Scientific Association are seriously considering the plans for sinking a giant shaft many miles below the surface of the earth, and estimates of expert engineers place the cost of a 12-mile deep hole at $25,000,000, and allow 85 years for the completion of the undertaking.

While the scheme may at first thought seem an insane one, is it really any more so than the ever recurring attempts to reach the North Pole? As a matter of fact the project is more likely to be productive in valuable knowledge, and there is even the possibility, though not the strong probability, that rich minerals may be found to reward the projectors, or their posterity.

Two deep holes, each about one mile in depth, have been sunk, one in Silesia and another in South Africa, but no one has ever previously planned to go down 10, 20, or 50 miles into the bowels of the earth and diagnose the symptoms there prevailing. The plans and estimates of the work are already well started under the direction of the Hon. Charles A. Parker, of the Engineering Section of the British Association. The engineers assume that for the first four or five miles the temperature would not be unbearable, but below that point resort would be necessary, to air locks and a freezing process which would make the hole tenable to human existence. The experts have that all planned out, however, and the freezing system of M. Poesche, a noted Belgian engineer, is believed to answer all the requirements for the second 12 miles or so.

Depth.	Cost.	Time in years.	Temp. of Rock.
2 miles.....	$2,500,000	10	122 deg. F.
4 miles.....	5,500,000	25	122 deg. F.
6 miles.....	8,000,000	40	182 deg. F.
8 miles.....	13,500,000	55	212 deg. F.
10 miles.....	18,500,000	70	242 deg. F.
12 miles.....	25,000,600	85	272 deg. F.

The possibilities of a rich "find" are certainly attractive: it may be a bed of diamonds, or other precious stones. There may be strata of gold or silver as great as those of hard coal in Pennsylvania; or vast ledges of mercury or tin, or even the more common but still highly valuable deposits of lead, or copper, or zinc. In any event the geological discoveries could not fail to outrank many times any results possible to bring back from either the South or North Pole. The more one reflects on the undertaking the greater the desire to know what is down below us, and whether a single rock stratum is miles in thickness. Canyons on the surface show frequently several strata.

Then there is the possibility of tapping a great lake of oil which could not be exhausted in centuries; or some heat-giving center which might last for thousands of years. With electrical transmission perfected to its fullness might it not be possible to send to all parts of the world electrical energy for power; or for transformation into heat that would temper the Arctic zone until the vines and fruits of Italy could bloom throughout the year.

All this sounds chimerical: but is it?

We know much; but not all knowledge will pass away with this generation.

How long did Galileo contend for his theory? And to how many was it given to really believe that Columbus was other than an insane rover?

The ancients did many things we are still vainly trying to imitate, and every little while evidence appears that some of our proudest achievements were practiced thousands of years ago. However, history inclines to the belief that their efforts were directed toward raising lofty towers and rearing pyramids rather than digging holes in the ground.

Have we then at last really discovered something new to do? If so, let us all cheerfully chip in and put in operation at the earliest possible moment the deepest hole which has ever been dug by any world.

HOW TO MARK TITLES ON NEGATIVES.

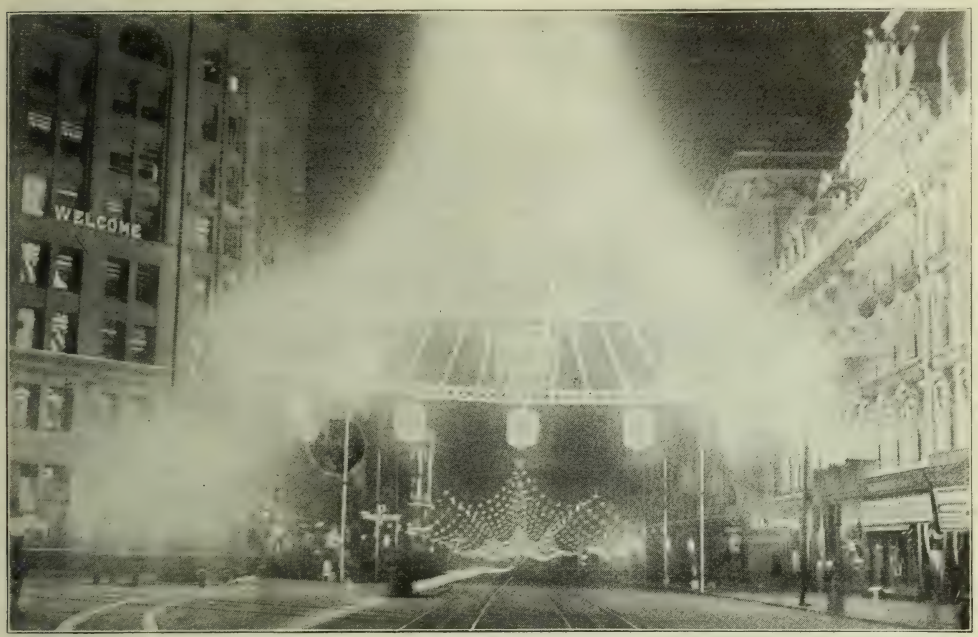
Marking titles on negatives so they print white on the picture is a very simple matter and may be done in either of two ways.

Write the name backward on a corner of the negative where there is a shadow, using India ink, or write it upon the paper before printing, using India ink in that case, also. The ink will wash off in the after-treatment and leave the title in white lettering, says the American Amateur Photographer.

It is rumored that two big American shipbuilding yards have taken contracts, one to build a fair-sized navy for Japan, and the other for 13 torpedo boats for Russia. The contract with Japan calls for 14 battleships and cruisers. At Lewis Nixon's ship yards at Perth Amboy the skeletons of 10 torpedo boats, each 100 feet long, have taken shape. The boats will be propelled by standard gas engines.

BRILLIANT ELECTRIC DISPLAY AT A SAN FRANCISCO EVENT.

The electric illuminations on Market street, San Francisco, during the convention of the Knights Templar recently held there



"The Street For Many Blocks Was Clothed in a Scintillating Effulgence of Electricity"

was one of the most brilliant and beautiful displays of the kind ever made in this country. Thousands of lights with varihued globes were used in carrying out the elaborate decorative designs, and the street for many blocks was clothed in a scintillating effulgence of electricity.

We are indebted to W. L. Woodworth of San Francisco for the illustration.

ELECTRICITY FOR STEAM ROADS.

In an address before the Electrical Congress in St. Louis, B. J. Arnold said:

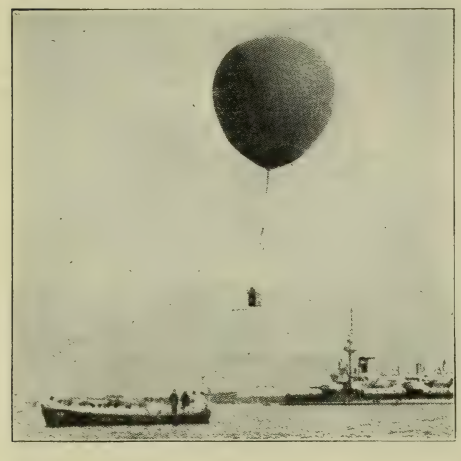
"It may be taken as axiomatic that when investment is taken into consideration, power cannot be produced in a steam central station, under conditions that exist today, and transmitted any great distance to a single electrically propelled train, requiring from 1,000 to 2,000 horsepower to keep it in motion, as cheaply as a steam locomotive, hitched directly in front of the train, will produce the power necessary for its propulsion. Therefore there must be other reasons than the expected economy in power production to warrant the adoption of electricity on a trunk line railway unless it can be shown that the trains are frequent enough to make the saving in the cost of producing power greater than the increased fixed charges made necessary by the increased investment due to the adoption of electricity.

That electricity will be generally used on our main railway terminals, and untimately on our main through lines for passenger and freight service, I am convinced, but I do not anticipate that it will always be adopted on the grounds of economy in operation. Neither do I anticipate that it will come rapidly or through the voluntary acts of the owners of steam railroads, except in special instances.

During August 8,649 pieces of baggage were handled daily at the Union station, St. Louis. This is nearly twice the amount handled during August of last year and 41,000 pieces over July. A remarkable fact is that trunks composed 94 per cent of the baggage handled.

FRENCH TEST NAVAL BALLOON.

In aerial navigation the French are ahead of all other nations of the world. Even the wily Brazilian, Santos Dumont, claims it as the loved country of his adoption. Re-



Test of French Naval Balloon

cently the French Navy has made thorough and severe tests of a balloon as a naval adjunct. The French are sanguine of the ultimate success of the balloon and the airship as important features of all great navies.

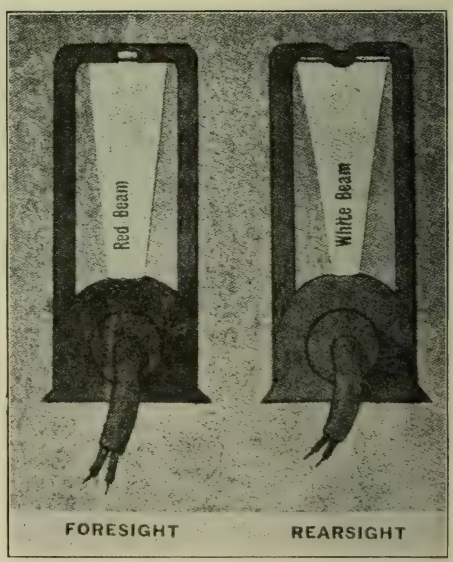
ELECTRIC NIGHT SIGHTS.

A ship engaged in a night attack is shrouded in complete darkness which is secured by closing all the dead-lights with which every scuttle is fitted, and switching off the dynamo from the incandescent lamp circuit. No lights of any description are allowed on the upper deck, and the consequence is that the guns have to be worked in complete darkness, this necessitates the use of "night sights." These consist of tiny lanterns containing very small glow lamps which are rendered incandescent by batteries.

The lanterns are joined in fork to the battery, and are easily shipped on to the ordinary day sight. Now the form of sight used in daylight is as follows:—The foresight consists of a "pea" or bead mounted on a knife-edge, and is fixed—that is to say, it does not alter its position to allow for deflection or distance; the rear sight, on the other hand, may be screwed laterally along a scale to allow for deflection and windage, and can also be raised or lowered vertically according to the range. It is H-shaped, consisting of two uprights crossed by a thin bar. In order to get a correct alignment the captain of the gun trains until the bar of the rear sight directs the "pea" for elevation, and until the "pea" is exactly sideways between the uprights for direction.

Now very naturally the captain of the gun being used to this method of sighting requires as close a representation of the bar and "pea" for his night sights, as possible, and a very good imitation is obtained by reflecting the light of the rear sight in the form of a bright line, and that of the fore sight in the form of a bright spot.

For this purpose a U-shaped piece is fitted on to the lantern immediately above the beam of light, and in the fore sight a tiny mirror of polished metal is let into the center of the inverted U frame at an angle of 45°, this reflects the light in the form of a small red speck. The rear sight has a slight depression in the center on either side of which a strip of polished metal inclined at



45° reflects a line of light broken in the center where the depression is. The reflection of the fore sight is red, and thus the captain of the gun trains until his red spot is just filling the break formed by the depression, in the line of light that is visible as a broken white band upon his rear sight.

The United States owns 1,200 steamships, while Great Britain has 8,500.

THE TELEPHONE IN THE WHITE HOUSE.

Where and How the President of the United States Holds Telephonic Conferences and Sends Telegrams and Cablegrams

One of the busiest spots at the White House is the Telegraph and Cipher Bureau, which is never closed, day or night, year in and year out, and where hundreds of messages dealing with vital affairs of state and having to do with the welfare of a great nation are received or sent daily. In all, 65 wires converge in this room and, including the President's private code, telegrams and cablegrams are sent in 10 different codes.

President Roosevelt will not have a telephone instrment in his private office, but goes to the telegraph and telephone room in the White House, where he is frequently engaged in long-distance conversations for some time, as during the anthracite coal strike when he was thus engaged with the leaders of both sides, frequently for long intervals. The central telephone station in this room is so arranged that the President can talk with any government official in Washington without the message passing through the city central office.

Copyrighted by Waldon Fawcett

Telegraph and Cipher Bureau at the White House

PROGRESS OF MARCONI SYSTEM.

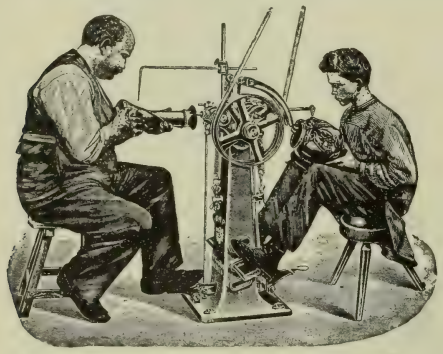
The Marconi system is now successfully transmitting messages 1,500 miles to sea, which leaves a gap of about 500 miles which is not positively covered. That is, a vessel sailing from Liverpool is in communication with the English station for the first 1,500 miles and is then without service for 500 miles, or until it enters the 1,500-mile zone served from the station on this side. Marconi having accomplished this, shall we doubt his ability to connect up the entire distance? His visit to America during October was to arrange for greater power which he believes will solve the difficulty.

While here he stated: "Though thus far the experiments have been imperfect, they have mainly failed because of lack of power. I purpose to increase that of the Cape Breton station, and I have new appliances for a more perfect radiation for the

electric waves. I believe that I can overcome the long distance with more power. The Cunard steamships now get their bulletins readily and accurately when 1,500 miles from shore. With sufficient power the remaining distance across the sea can be overcome, I believe. Recent experiments in Italy developed curious phenomena which distance only cannot explain."

INGENIOUS EMBOSSING MACHINE.

Decorations on metal vessels have been largely the result of hand work, and consequently expensive. When these figures are raised the process is known as relief work; when they are indented, it is repoussé. A German inventor has produced a machine which will do both processes,



Embossing Machine

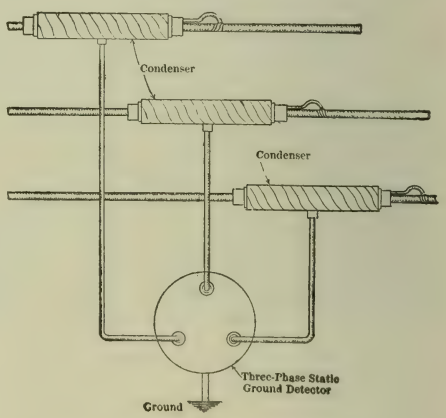
which he accomplishes by small, pointed hammers—one outside and one working inside the vessel. The Metal Worker describes the process thus:

In effect, the work is done as follows: The design is either drawn or stenciled upon the outside of the vessel to be decorated. The arm of the embossing machine, upon the end of which a hammer is fixed, is introduced into the neck of the vessel, and is followed on the outside by a pointer, which shows exactly where the head of the hammer will come in contact with the metal within. The belt is then shifted and the machine is started. Three speeds are at the disposal of the operator; namely, 900, 1,200 or 1,600 taps of the hammer per minute. The pointer is held directly above the point of attack, and, though out of sight, the hammer must strike directly under it. Variation in the force of the stroke is often desirable, and for this provision is made, the varying force being produced by a pedal placed within convenient reach of the operator's foot. A strong pressure upon this pedal will stop the machine altogether when necessary.

THREE-PHASE STATIC GROUND DETECTOR.

An instrument is now available for testing grounds on three-phase circuits of from 1,000 to 50,000 volts potential. The previous method of combining two or three single-phase instruments has been unsatisfactory because slow. The diagram, from the Street Railway Journal, shows how the new device operates.

It will be seen that each of the three fixed vanes is connected to a line of the three-phase circuit. The central movable vane is electrically connected to the case, which is grounded. When there is no ground upon the circuit the attraction or pull upon the central vane from each of three fixed vanes is balanced and it does not deflect from a central position. Should one of the lines become grounded, and the potential of that line become the same as that of the movable vane, there will be no pull in that direction, and the movable vane will be deflected away from the grounded line. The instrument is reliable in its indications and is not complicated.



In the diagram the three leads to the ground detector are shown with a condenser inserted between each line and the instrument. This obviates the necessity of carrying high-tension wires to the front of the switchboard. Each of the condensers consists of a brass tube covered with insulating material and placed within a copper sheath, the line being connected to the inner tube and the lead to the copper sheath.

Harvesting Grapes in America's Vineyards

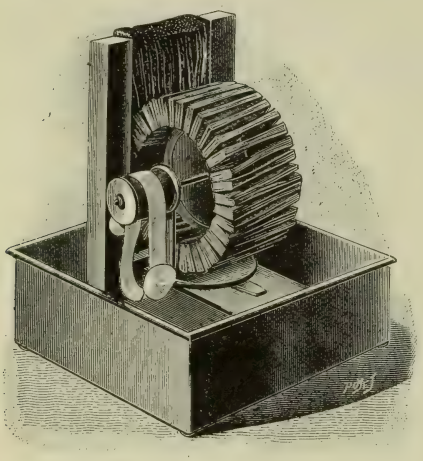
A Vineyard Scene Typical of Michigan, New York and Many Other American States Where Grapes Are Purpling for the Harvest, in Great Lucious Clusters

Where Hundreds of Thousands of Grape Baskets Are Turned Out Annually

A CAPILLARY MOTOR.

Little Invention May Lead to Important Applications of the Principle.

A Frenchman, M. Leboyer of Riom, has contrived a little motor out of a few pieces of blotting paper, some rocks and a piece of tinder which utilizes the capillarity of certain substances for liquids and turns it into a force. The little motor is very simple in operation and may lead to further important developments.



A Capillary Motor

We all know how readily the wick of a lamb absorbs oil and carries it far above the level of the liquid through the burner where it feeds the flame. One may experiment by holding a strip of blotting paper vertically in a little water and noting the height above the water to which it becomes moistened by this same capillary action. This power of imbibing water varies, of course, with the substance. The inventor of the capillary motor, who has a most observant eye for natural phenomena, discovered a rock which imbibes liquids when placed vertically in them, sometimes to a height of four inches above the level of the liquid.

In making the motor he placed two oblong sections of this rock vertically in a basin full of water and at the top between the two rock supports arranged a piece of amadou or German tinder, a very porous inflammable substance made of fungus growth. The lower end of the tinder came in contact with a wheel formed of blocks of blotting paper placed edgewise around its whole circumference. Upon the axle of the wheel is arranged a band carrying two tiny buckets. The water rises through the rock supports, is imbibed by the porous tinder and again by the blotting paper wheel which the tinder touches. The whole left side of the wheel becomes so heavy with water that the wheel turns and once more its equilibrium is established by the rest of the wheel absorbing water. When the water in the opposite side has evaporated sufficiently to again destroy the equilibrium the wheel again turns. The rapidity of the revolutions depends of course on the condition of the atmosphere. In the meantime the little buckets rise and descend with every revolution of the wheel lifting water about four inches. The motor, of course, acts very irregularly and lifts only a little water in 24 hours.

The motor can be easily constructed by anyone who wishes to try the experiment for himself.

AUTO REPLACES MULE.

The superintendent of a big sugar plantation in Louisiana has adopted an automobile for inspection trips over the fields.

Inspecting Sugar Plantation

The roadways are kept up in good condition on account of the great amount of hauling during the year, and the change from mules to machine was an easy one and a great saving in time.

In the million dollar subway at the Union station, St. Louis, no provision was made for drainage. It filled with water a few days ago and will have to be reconstructed before use.

A COASTER CLOCK.

Rolls Down Hill for 24 Hours — Requires No Winding—Keeps Perfect Time.

A watch and clock-making establishment at Zurich has invented a clock which keeps time by rolling down hill for 24 hours. This mechanical freak spends the entire 24 hours

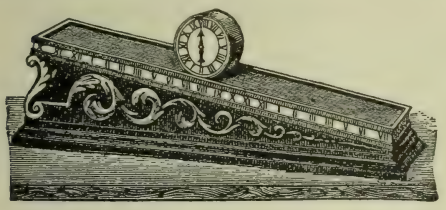


Fig. 1

in going to the bottom of the plane once. The distance it travels in that time is about 15½ inches and the clock rolls constantly but almost imperceptibly.

The clock is made in the form of a cylinder and the plane base is tilted at an angle of 20 degrees. When the clock reaches the bottom of the plane it is simply lifted up and placed at the top again. The clock has no spring and therefore requires no winding. The numerals on its face read from right to left instead of, as usually, from left to right. Along the upper edge of the inclined base is another time scale, the figures of which correspond exactly with those on the face of the clock. In indicating the time the numerals on the clock face pass behind a hand which always maintains its vertical position, despite the rotation of the cylinder, the upper end of the hand indicating the time by the numerals on the clock face and the lower end pointing to the corresponding numeral of the scale on the edge of the base.

"This invention though startling is very simple and not at all new," says the Keystone. "It is very clearly described in a book of mathematical and mechanical curiosities published in 1719."

The same paper goes on to explain the interior mechanism of the clock, referring to Fig. 2. Within and at the center of the cylinder, C, is fixed a strong clock movement, M, without a barrel. The apparatus thus constructed is balanced with the greatest care, for it is an indispensable factor in its proper working that no inequality of weight should be found upon the circumference of the cylinder. Placed upon an incline it is evident that such a cylinder would instantly roll to the bottom.

But let us suppose a weight, P, joined by an arm to the central axis and fixed upon it; this counterpoise if sufficiently heavy and placed behind the central perpendicular, would cause the cylinder to roll back or up the incline to the point where its equilibrium should be established—say in a position shown in the sketch. Without a train and an escapement the cylinder would remain thus immovably fixed upon the plane, but the weight, P, combined with the gravitating force of the cylinder, acts as motive power, and the center wheel, upon the axis of which is fixed the counter weight, turns at a rate governed by the escapement and the balance. The constant tendency of the weight is to fall, but it being impossible to destroy the equilibrium, the cylinder proceeds slowly down the incline as the retaining weight, P, is periodically released. Having finished its downward course, it suffices to place the cylinder again at the

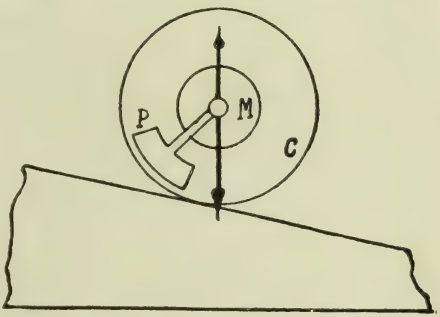


Fig. 2

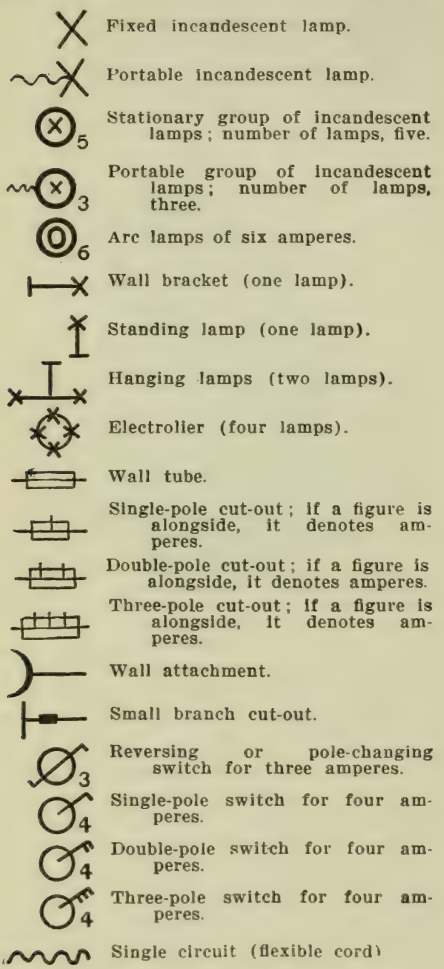
head of the plane upon the same hour as it marked when removed from below, to have it repeat the operation. We should not fail to remark that for a full 24-hour run our Fig. 1 is not properly divided on the plane; the numbers should begin with VI and end with VI.

This curious clock has attracted a great deal of attention wherever displayed. Great crowds gather to watch it and wonder and try to figure out just how it works.

"The building material of the future will be beton, it is predicted," says United States Consul Kehl at Stettin, Germany. The Germans are making many experiments with beton and claim that it is least susceptible to fire of all building materials in use, is cheap and is very durable.

CONVENTIONAL SIGNS USED BY FOREIGN ELECTRICAL DRAFTSMEN.

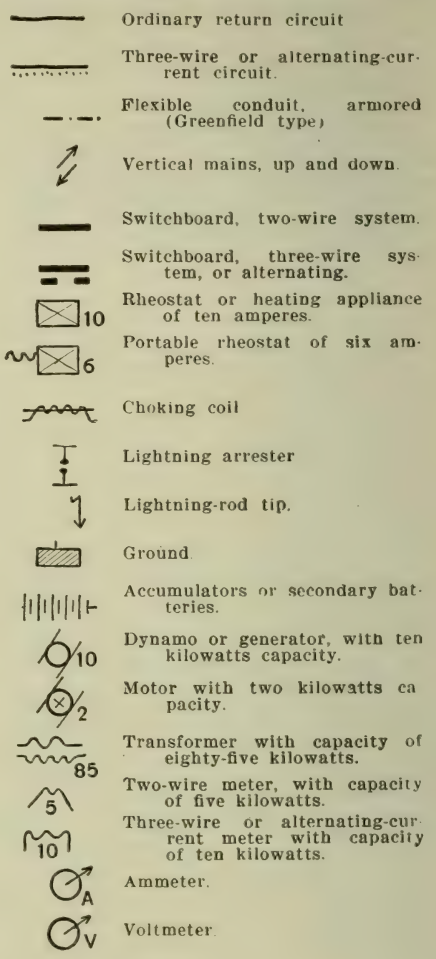
Blueprints and drawings laid out by German, Austrian and Italian engineers and draftsmen in their designs for wiring of buildings, etc., are generally most elaborate. Every little detail is shown in a most painstaking manner, and the signs here illustrated are universally used in the countries mentioned, to designate the material or apparatus to be used for proposed plants, says Arthur D'Romtra in the Western Electrician.


Fixed incandescent lamp.
Portable incandescent lamp.
Stationary group of incandescent lamps; number of lamps, five.
Portable group of incandescent lamps; number of lamps, three.
Arc lamps of six amperes.
Wall bracket (one lamp).
Standing lamp (one lamp).
Hanging lamps (two lamps).
Electrolier (four lamps).
Wall tube.
Single-pole cut-out; if a figure is alongside, it denotes amperes.
Double-pole cut-out; if a figure is alongside, it denotes amperes.
Three-pole cut-out; if a figure is alongside, it denotes amperes.
Wall attachment.
Small branch cut-out.
Reversing or pole-changing switch for three amperes.
Single-pole switch for four amperes.
Double-pole switch for four amperes.
Three-pole switch for four amperes.
Single circuit (flexible cord)

One readily gets accustomed to them, and I find that in estimating for foreign work, the use of foreign prints with these symbols greatly accelerates the capabilities of the estimate department. The following conventional symbols are used in the three above-named countries:

Conductors: B., bare copper; B. E., bare iron galvanized; G., seamless rubber insulation; L., flexible cords; K. B., bare lead-covered cable; K. A. lead-covered cable with asphaltum-taped cover; K. E. lead-covered cable, armored; g., conductors on insulators; o., conductors in iron conduit.

Firms making out plans and drawings to be used in the before-mentioned countries will do well to consider these symbols, and also carefully to add in figures the proposed amperes to be carried on each wire or cable.


Ordinary return circuit
Three-wire or alternating-current circuit.
Flexible conduit, armored (Greenfield type)
Vertical mains, up and down.
Switchboard, two-wire system.
Switchboard, three-wire system, or alternating.
Rheostat or heating appliance of ten amperes.
Portable rheostat of six amperes.
Choking coil
Lightning arrester
Lightning-rod tip.
Ground.
Accumulators or secondary batteries.
Dynamo or generator, with ten kilowatts capacity.
Motor with two kilowatts capacity.
Transformer with capacity of eighty-five kilowatts.
Two-wire meter, with capacity of five kilowatts.
Three-wire or alternating-current meter with capacity of ten kilowatts.
Ammeter.
Voltmeter

Dr. Niels R. Finsen, whose experiments covering many years sucessfully demonstrated the use of chemical rays as a curative agent, died in Copenhagen, September 24. His "Finsen's Medical Light Institute" gained world-wide renown in curing tuberculosis of the skin.

PLOWED WITH AN AUTOMOBILE.

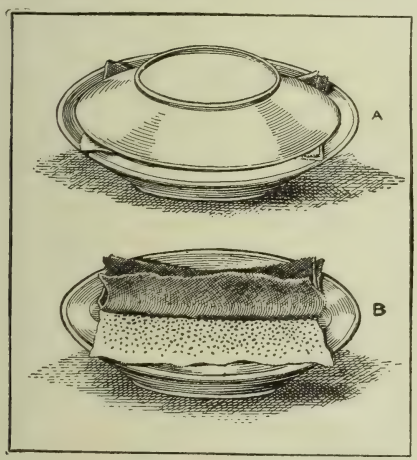
The automobile is put to many uses and abuses. Not long ago a Chicago physician used one to disperse a gang of hold-up men and now an eastern farmer has hitched one to a plow and is attempting to plow his fields with it.

The farmer first tried the combination in an effort to check a fire in a field of stubble and it was such a success that he began experimenting further. He found that the machine went too fast for the man at the plow handles to keep up with it. As another test the auto was attached to a mowing machine and a piece of ground which would have taken three hours to mow by horsepower was mowed in an hour with an automobile.

A SIMPLE HOME-MADE SEED TESTER.

A very satisfactory and yet simple seed tester for determining the per cent of seed which will grow can be made by any one. Mix the seed thoroughly and count out a hundred or so of the seeds, not making a selection but taking them as they come, says the Grain Dealers' Journal.

Put them between a fold of cotton flannel and do not allow them to touch one another. Place the cloth on a plate, moisten it well but do not saturate it. Cover it with another plate and keep at a temperature of



A Home-Made Seed Tester
A, Closed B, Open

about 70 degrees F. Take out the sprouted seeds every day, counting them. The good seeds will all have sprouted inside six days. The percentage that will grow can be determined from the total number sprouted.

HOW TO KEEP BICYCLE TIRES FROM CREEPING.

To keep a double-tube bicycle tire from slipping and pulling the valve stem it is only necessary to purchase a few common

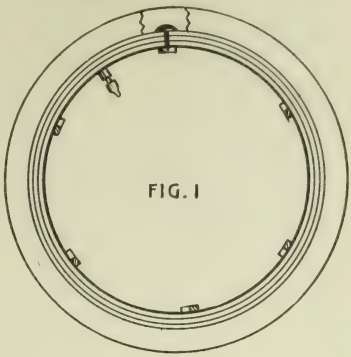


FIG.2

FIG.3

round head stove bolts (Fig. 2) just of proper length to reach through the inner edge of the casing and the rim of the wheel. Put the bolts in a vice and file to shape of Fig. 3. Care should be taken to make the heads as flat as possible and yet leave the edges perfectly round and smooth.

Take your wheel with the tire on and mark accurately the points on both rim and tire at which bolts are to be placed. Six bolts for a wheel of 36 spokes is plenty, while for 28 and 32 spokes the number of bolts would have to be changed to make the spaces between them of the same distance.

Drill holes in the rim, taking care to be exact, and also through the inner face of the tire. The inner tube should be removed while doing this, as it will be apt to get cut. The bolts can be let into the casing and worked around until they go through the holes with the head on the inside. Put the inner tube in place; lace up; apply cement and when the tire is put on and nuts tightened up it is on to stay. The bolts will not prevent the tire from being removed for repairing punctures.

One of our readers, Sern Madsen of Forest City, Ia., sends us this kink which he has himself tried and found wholly satisfactory.

HOW TOLL MESSAGES ARE TIMED.

The problem of timing long distance conversations at a big busy telephone exchange, where a great number of such conversations are held daily, might puzzle the novice who knows nothing of the accurate little apparatus which keeps tab on the minutes so exactly that it would be impossible to cheat the company.

This little instrument, known as the calculagraph, is a mechanical wonder. It prints the elapsed time without the least mental effort on the part of the operator further than to pull a lever at the beginning and the end of the conversation. "It mechanically subtracts the time of connection from the time of disconnection and prints the actual number of minutes and quarter minutes that elapse during the interval," says the American Telephone Journal, from which this description is condensed. A single calculagraph can be used for a large volume of business and two telephone operators seated at the same table usually have a calculagraph between them which they both use irrespective of the order in which the conversations come.

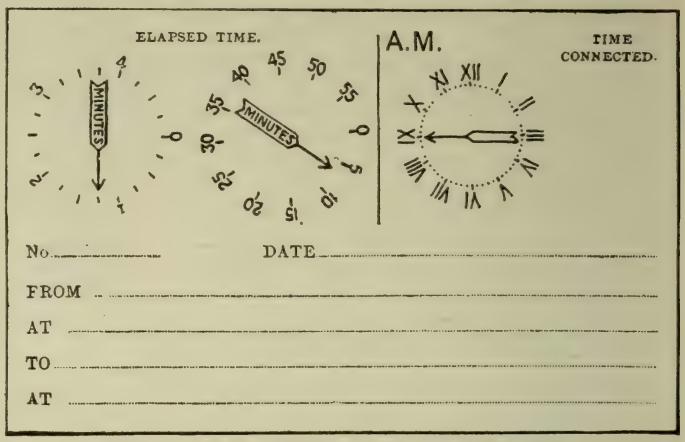


Fig. 1. Toll Ticket Showing Calculagraph Imprint

At Fig. 1 is shown a standard toll ticket bearing a calculagraph imprint which tells all that is required for the purpose. The right-hand dial shows the time of day the parties were connected for talking. A triangular pointer revolves around the outside of the dial to show the hour and the pointer within the dial indicates the minutes. In this instance it is 9:45 a. m. The other dials record the elapsed time in minutes and quarter minutes. The central dial or the one to the left of the line is one hour divided into 5-minute periods, while the left-hand dial on the card has a total of 5 minutes divided into quarter-minute periods. Thus, time spent in conversation is read on the two elapsed time dials.

The mechanism of the calculagraph is detailed in Fig. 2, which shows how the center elapsed time dial is printed. At the top of a shaft, b, is permanently mounted a pointer die, a, which revolves with the clock mechanism. A forward movement of the handle, L, forces the shaft up and if a card is inserted between the inking ribbon and the platen an impression of the arrow-shaped pointer will be printed on it. A dial die, with a sleeve-shaped stem, d, is also mounted on the pointer shaft, b, and revolves with it. A forward movement of the handle, R, forces the stem, d, upward without lifting the pointer shaft and that operation prints a dial like the central one in

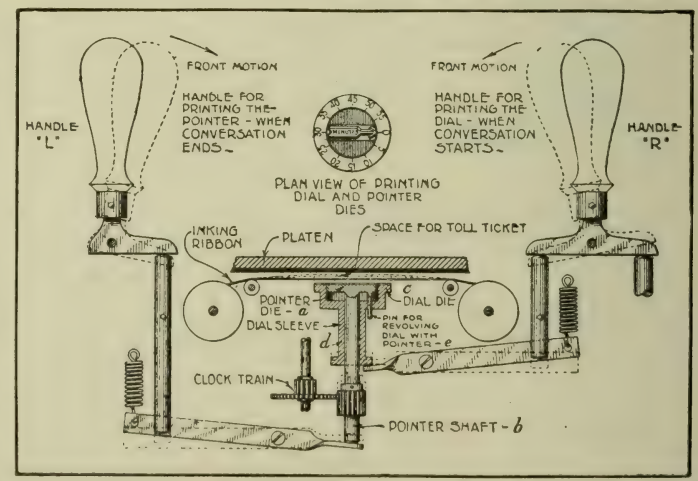

FRONT MOTION
HANDLE FOR PRINTING THE POINTER - WHEN CONVERSATION ENDS -
HANDLE "L"
FRONT MOTION
HANDLE FOR PRINTING THE DIAL - WHEN CONVERSATION STARTS -
HANDLE "R"
PLAN VIEW OF PRINTING DIAL AND POINTER DIES
INKING RIBBON
PLATEN
SPACE FOR TOLL TICKET
POINTER DIE - a
DIAL SLEEVE - d
c DIAL DIE
PIN FOR REVOLVING DIAL WITH POINTER - e
CLOCK TRAIN
POINTER SHAFT - b

Fig. 2. Mechanism of the Calculagraph

Fig. 1, but without the pointer. To make the dial and the pointer revolve together a connecting pin, e, is used, so causing the arrow to always point to the zero mark on the dial. Either the dial die or the pointer die can be forced upward separately without causing the other to make an impression. In practice the dial is printed at the beginning of a conversation and the arrow at the end, both having moved forward during the interval so that the arrow when printed points toward the figures on the ticket which express the elapsed time.

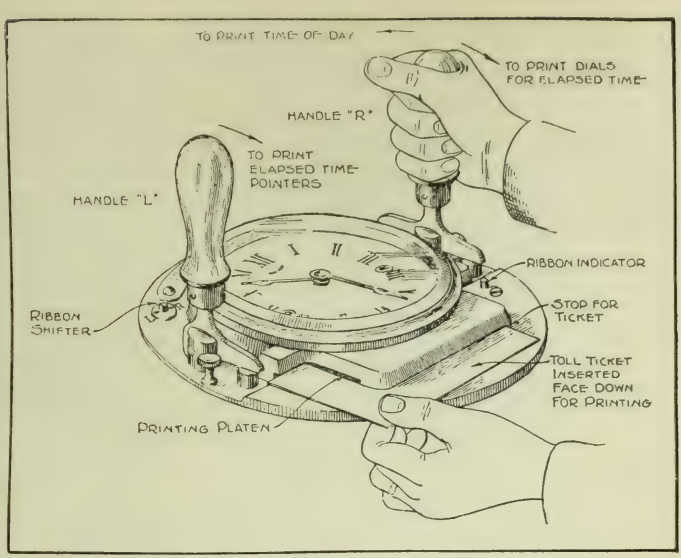


Fig. 3. Operating the Calculagraph

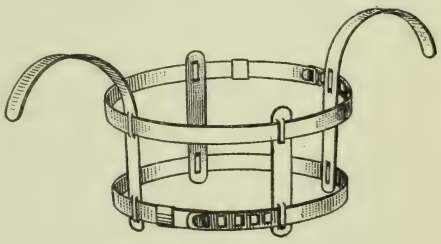
To operate the calculagraph (Fig. 3) a ticket is inserted face down in the slot at the front of the instrument, with the top edge and the end of the ticket against the guide and stop. This is done at the beginning of the toll conversation. Then the right-hand lever, R, is pushed backward and again pulled forward, each time to the limit of the movement. The backward movement gives the imprint which tells the time of day the conversation began and the forward movement prints the two elapsed time dials, but without the arrows. The ticket is then immediately removed from the slot, so that the calculagraph is free to be used for other records if needed. When the party talking has finished, the card for his conversation is promptly inserted in the ticket slot just as before and this time the lever, L, is pulled forward and the movement prints on the card and within the elapsed time dials two arrow-shaped pointers, which point toward the figures and division marks which indicate the elapsed time in minutes and quarter minutes.

The printing mechanism of the calculagraph is so adjusted that it in nowise interferes with the regularity of the clock. The work is performed without noise or jar and does not interfere with the free operation of the switchboard.

The Union Iron Works at San Francisco are to be enlarged and made the finest in the United States, if not in the world. The improvements in the works are already under way.

HOLDS MILK PAIL WHILE MILKING.

A New Jersey man who grew tired of holding the milk pail between his knees while milking has patented the device shown in the illustration. The pail fits into the frame nicely and the curved arms fit over the milker's legs above the knees, thus



For Holding the Milk Pail

supporting the weight of the pail. The circular frame is adjustable to any size pail and the contrivance can be arranged to tilt the pail at any angle desired.

AMERICANS USE PLENTY OF SALT.

The production of salt in the United States for 1903 was 18,968,089 barrels (of 280 pounds), valued at $5,286,988. The domestic consumption was greater than the production, as it usually is, being 20,062,587 barrels. The United States ranks second in the production of salt, Great Britain being a little in the lead.

DETACHABLE CYCLE MOTOR.

May Mean the Solution of Individual Rapid Transit

An English manufacturer has put on the market a detachable motor for bicycles. The motor is supported at one end by the bicycle—which may be of any make—and at the other by a single trailer wheel. The power is a small gasoline engine. The advantages of the arrangement are evident. First of all, the man who already has a wheel need buy only the motor part; the weight is carried so low that the outfit is not top heavy, as with present types of motorcycles, and there is very much less vibration and jar as the machinery is carried on the rear wheels.

The flow of gasoline and the usual control of the motor is entirely at the rider's command, being regulated by levers at the handle bar.

The cost is not at all excessive, the price of the attachment complete being only $75 to $80. One of these machines has already covered over 3,000 miles without repairs or apparent deterioration. The motor drives by a chain to the hub of the rear large wheel, and weighs 60 pounds. The total weight of wheel and motor attachment is thus under 100 pounds, an amount which permits of easy handling. The Model Engineer, London, says there is a patent in England on the attachment but none on the engine as any suitable motor may be used. The machine makes as high speed as any motor cycle, is a good hill climber and operates with engines of from 1¼-horsepower up.

The attachment wheel facilitates rather than retards the steering, and inasmuch as no extra strain except that of speed is imposed, present type bicycle frames are found to be amply strong. The supply of gasoline carried on the wheel illustrated is sufficient for 100 miles. The only alteration in the bicycle to be used is a new hub for the driving wheel, and this is easily applied.

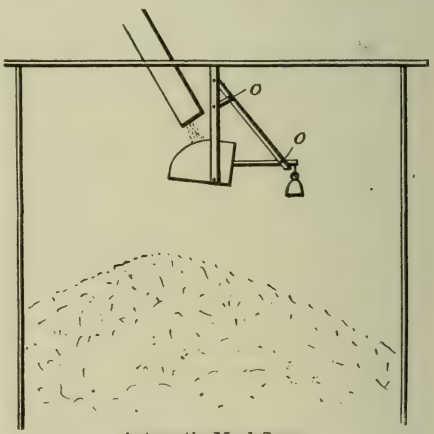
Does this mean the solution of individual rapid transit by mechanical means for which hundreds of thousands in our large cities have been waiting so long? If the machine when it first appears can be sold for $75 is it not reasonable to expect that by producing in enormous quantities they can be made and sold at a fair profit for $50? Sewing machines dropped from $150 to $25; bicycles did the same. Any device which is capable of an universal sale warrants large plants equipping to produce in large quantities.

While there will doubtless be many improvements the idea seems a good one and to possess staying qualities. The uses to which the machine can be put includes all that are now served by the bicycle and many times more. Every doctor could use one for emergency work, for he could cover several miles with such a vehicle while his horse was being put in harness. Police and fire departments, and workmen engaged in emergency repairs of all kinds would find it usable for large numbers of men. Workmen of all kinds, clerks, professional men who need the fresh air, which a daily trip in good weather affords would swell the army of users. In addition the reduced price would appeal to thousands of pleasure riders.

AUTOMATIC MEAL SCOOP.

A correspondent in the American Miller says:

For years we were troubled by the fact that our unbolted meal, when spouted into the bin in a steady stream, would separate, and require mixing to keep it even quality and weight. To correct this difficulty we contrived the "wrinkle" here sketched, and with the result that no matter how fast or how slow we grind, or how full the bin



Automatic Meal Scoop

gets, our unbolted meal is always even. The contrivance is easily made, and costs but a trifle.

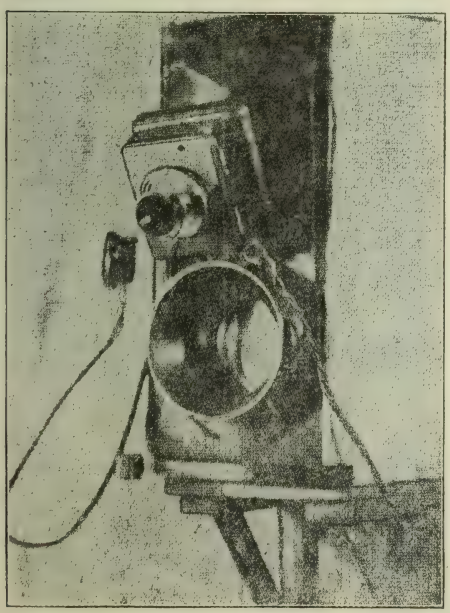
The weight arm has a sweep of the distance between points marked "O." Make scoop about 6 inches wide and 9 inches long by 6 inches deep. Hang so that stream strikes at center of top of scoop. Place bar across frame at points "O" to support and retard weight arm. Adjust weight so as to properly return scoop when empty and hold same in position till full.

SEEING BY WIRE.

Two Senses Combined in the Telephone — See Over Miles of Intervening Space

Seeing over the telephone! Looking into the face of the other fellow, miles away perhaps, and yet noting very fleeting change of expression. This is the invention which, unheralded, hardly to be credited, has startled the world more than did the transmission of sound over miles of wires. In transmitting sound the delicate little disk in the mouthpiece of the telephone passes the sound waves created by the spoken word along the electrified wire to the disk of the receiver at the other end of the line where they repeat their message into the intent ear. But in seeing over the 'phone much more is involved. It is not the unchanging look caught and recorded by the camera; it is the active, intelligent semblance of life, of color, of action, substance and form, multitudinous combinations of waves of light and the transmission of these over miles of wires is what is involved in seeing by telephone. And yet the device that can perform this wonder has actually been invented and even now is carefully guarded from the peering, eager eyes of a curious and unscrupulous world.

When J. B. Fowler of Portland, Oregon, the inventor of the device, was a young man he worked in a glass factory at Bellaire, Ohio, and every day he took a long list of



Telephone by Which One Can See the Speaker at the Other End of the Line

J. B Fowler
(The man who made seeing by Telephone possible)

orders for the factory over the 'phone. One night after being so employed for several hours during the day he dreamed that he was giving a theater party to a number of friends in Bellaire, but that the play was being enacted in Wheeling, W. Va., four miles away, and was presented to the party over the 'phone by means of a combination of wires, lenses and disks, the scenes being thrown by a stereopticon on a canvas while the voices came over the 'phone. This improbable dream, this wild flight of slumber vision was the germ from which Mr. Fowler's invention grew—grew through long years, silently but persistently.

The wonderful telephone in the home of the inventor appears to be very little different in its main features from the ordinary telephone. It is merely a box nailed to the wall from which projects a mouthpiece and a lens. What the connection with this lens, how the waves of light are transmitted, no one knows: that is the inventor's secret; the only information he will give being that it is entirely independent of the 'phone. In demonstrating, his daughter went to one end of the line two rooms away and on looking through the lens her face in color, contour and expression was plainly visible. As she spoke the motions of her lips were apparent and she drew various cards from a pack and held them before the lens and each one could be distinguished at the other end of the line.

Mr. Fowler expects to perfect his invention before giving it to the world. In his

own words he hopes to do wonderful things with it. He says:

"I am certain that it can be attached to the telephones of the city so that the people will be able to see the person with whom they are conversing. In time I hope to be able to so arrange it and enlarge its scope that a patron can sit at his desk or in his home and see a baseball game, a prize fight or a play at the theater with perfect ease and accuracy. I expect that it can be so perfected that the train dispatcher can sit at his desk and watch his trains swing into the different stations along the road and depart. In fact, the scope of its usefulness is unlimited, and I am confident of success. I have the principle, and time and study will improve it until it will be a thing as marvelous to the minds of the present generation as was the first telephone to the generation of yesterday."

PRICE OF RUBBER ADVANCING.

Crude rubber now costs $1.20 a pound in New York, the principal receiving port for this much used commodity. Thus far no satisfactory substitute has been discovered for rubber, and the demand is steadily exceeding the supply. The cultivated rubber trees in American and native plantations in Mexico have not yet come into bearing to an extent to relieve the stringency. In fact they are not likely to do so for years to come on account of the new inventions coming out which must use rubber, and to the increasing manufacture of articles which cannot be made of any other material.

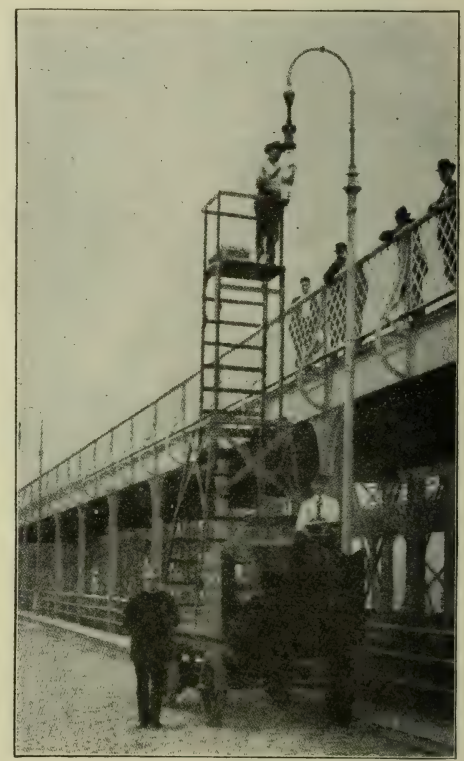
There are not hundreds, but thousands of articles in which no substitute for rubber has yet been found and for which no substitute is likely. Electrical manufacture makes heavy demands; makers of overshoes and rain coats use hundreds of tons; automobile tires have been the latest largest addition to the demand, while the multitude of small things from a rubber band to garden hose combine to produce requirements that are already enormous and constantly increasing.

A rubber plantation costs money and several years to come into production, but when once it does begin to yield returns they are large and very profitable. It has apparently been left to Americans to grasp the necessities and possibilities of the situation and they are going at the matter in the broad-guage manner that is characteristic of their operations. The chief regret is that they cannot make the trees grow within their own borders.

The production of rubber from the Amazon River district for the past year and exported was: To Europe, 34,061,482 pounds; to the United States, 33,253,109 pounds. The total increase exported over the previous year was only 1,558,543 pounds.

TRIMMING ARC LAMPS BY AUTOMOBILE.

The position of lamp trimmer for a big lighting company in Philadelphia is one of comparative pleasure these days. Instead of making his rounds on foot carrying a ladder on one shoulder and a leather bag of



Trimming Arc Lamps by Automobile

carbons from the other, he now has his chauffeur and rides in state.

The Western Electrician says: The platform, when extended to its full height, is 19 feet above the roadway, and it collapses to 14 feet. By means of this conveyance all the lamps on the bridge, which number 128, can be attended to in half a day, which means a saving of 50 per cent in time and labor.

SHOP NOTES

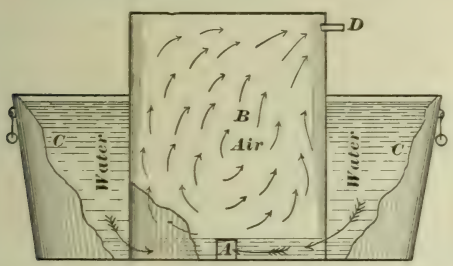
A BOILER GOING INTO DISUSE.

A boiler when about to be laid up for a season should be thoroughly cleaned on the inside, filled with water with steam on so as to be full of hot water that has been boiled, up to the safety valve. The flues and fire surface of the boiler should then be cleaned and ashes and soot removed from every part where such have lodged. Then close fire doors and ash pit, and put a cap on the smokestack. With this treatment laid-up boilers do not rust inside or outside. It is the moist air drawn through a laid-up boiler that does damage by rust.

IMPROVISED AIR COMPRESSOR.

Having been working fifteen miles from a railroad station in Alabama, putting in water pipes in a house, one day my blowpipe attachment to the firepot broke. After finding that I could not mend it, I constructed the "air compressor" shown in the accompanying illustration.

Securing an old lard can (designated B in the drawing), I cut the hole "A" in the side of it where the lid was formerly placed. Next I punched a hole into the side down near the bottom and inserted the tube "D." Then I got a wash tub "C" and filled it nearly to the rim with water, and taking the lard



Emergency Air Compressor

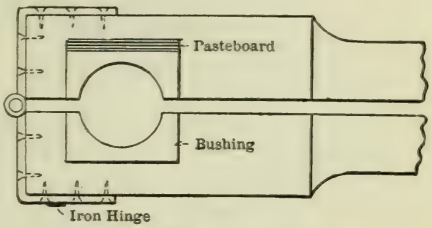
can and putting it upside down into the water and pressing it downward, the air came out of the tube "D," being forced up by the water pressure which entered the can at the inlet "A." I then attached a ⅜-inch rubber tube to the outlet "D" and the other end of the tube to the firepot, and I had an excellent pressure.

THE PLUMBER.

A CONVENIENT POLISHING CLAMP.

A polishing clamp which would be hard to improve upon in point of convenient features was contrived by a correspondent of the American Machinist.

The jaws or levers of the clamp are cut out so that a square block of standard size fits in snugly. Instead of boring a hole in the levers which would fit but one



A Polishing Clamp Improved

size of shaft, the hole is bored in the square block, and other blocks having other sized holes may be fitted in as required. In this way if a hole becomes so worn as to be unfit for further use the block may be discarded and a new one provided, or pieces of cardboard may be packed in between the bushing and the lever until the levers are held as far apart as they were in the first place, whereas without the blocks the whole clamp would have to be discarded.

Another good feature of this clamp is the manner in which the levers are joined. Instead of a strip of leather tacked to the wood, an ordinary iron hinge is used, the ends of which are bent to conform to the shape of the lever ends.

SOLDER FOR SEALING CANNED GOODS.

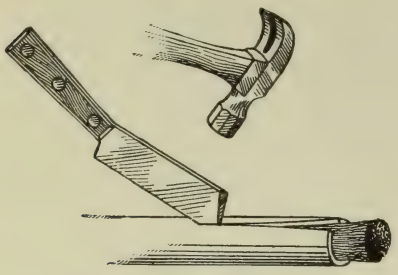
A good solder for sealing the tops of canned goods is made as follows: Melt 1¼ pounds of lead, add 2 pounds of tin, and then stir in thoroughly 2 ounces of bismuth. This makes a soft solder, and a very little heat will open the cans when desired.

TINNING BRASS AND COPPER.

Boil the article to be tinned with tin filings and caustic alkali or cream of tartar. The tinning will be perfect.

CABLE-SHEATH-CUTTING KNIFE.

A new invention on the market, which is filling a long-felt want with telephone men and all those who have to do with the laying of cables, is a knife for cutting cable



Knife for Cutting Cable Sheath

sheaths. The knife is very simple to operate and does the work quickly and neatly. The illustration explains its use fully.

ISAAC BABBITT DID NOT INVENT BABBITT METAL.

The soft alloy called Babbitt metal was not invented by Isaac Babbitt, as many infer. Instead Mr. Babbitt only invented the method of using the alloy in journal boxes, with which method the alloy became so closely associated that it naturally came to pass that it was called Babbitt metal. The metal he recommended was britannia metal, pewter, or an alloy of tin 50 parts, antimony 5 parts, and copper 1 part, an alloy somewhat softer than that now known as Babbitt metal, which is composed of tin 96 parts, antimony 8 parts, and copper 4 parts. The idea of using it was much the same, however—that is, to make a bearing which would conform to the surface of the axle.

Isaac Babbitt was born in Taunton, Mass., July 26, 1779. He learned the goldsmith's trade, and in 1784 made the first britannia ware which was produced in this country. This enterprise was not successful, however. He moved to Boston, entered the employ of the South Boston Iron Works, and in 1839 produced his great invention, for which he was given a medal from the Massachusetts Charitable Mechanics' Association, while Congress granted him a reward of $20,000. The invention was patented in England in 1844, and in Russia in 1847. He spent some time in the production of metals, and then manufactured soap. His life had an unhappy ending, for he died insane at the McLean Asylum, Somerville, Mass., on May 26, 1862.

HOW TO CLEAN SPARK PLUGS.

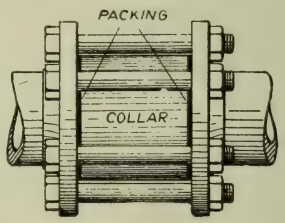
All that is required for the proper cleaning of spark plugs which have become sooted or carbonized are a toothbrush and some gasoline, says the Automobile. The spark points must not be rubbed too vigorously or they are apt to break off. If the plug is carbonized so badly that it is difficult to clean it with a brush, use a blunt knife which has a soft blade. A hard blade will tend to develop cracks by scratching the glazing on the porcelain, as will emery cloth also.

If a plug of suitable design cannot be obtained, and it is necessary to use one of a different design, be sure that the spark points do not project far enough to short-circuit the bottom of the plug recess or inlet valve. In that case remove the plug and put on an extra gasket.

PIECING OUT A STEAM PIPE.

"After putting in new piping to an engine, it was found that one of the pieces had been cut 3 inches too short," says a correspondent of the Engineer, who tells how he got around the difficulty by piecing out the pipe.

An old cast-iron slip collar was taken from the scrap pile and the set screw holes



Showing Ring in Place

were plugged with patch bolts and the extra length sawed off. The slip collar was then put in the lathe and bored out to the size of the pipe, 5 inches, and it was then turned down until it would just fit inside the flange bolts, which gave a ring of metal a little over an inch thick. This was faced down to 2¾ inches, making room to put a rubber gasket between each end of the collar and pipe flanges. When drawn tight the joint was complete and though made some time ago has never given any trouble.

REMOVING STUBS OF BROKEN SET SCREWS.

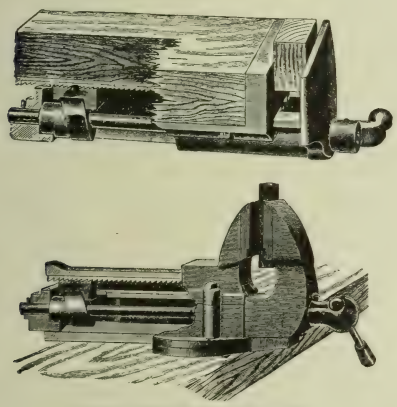
To remove set screws which have been broken or twisted off do not drill them out for that injures the thread and is apt to make it necessary to cut deeper where sometimes a larger screw cannot be used.

A good way, says a correspondent of the Blacksmith and Wheelwright, is to take a good piece of tool steel and make a strong drill bit to fit the drill. Make the drill bit left-handed so that it will turn backward and draw out the broken screw. First cut a notch in the screw with a chisel; then put in the drill and turn the drill backward, being careful to keep the drill in the notch. Nine out of ten can be taken out in this way if they are not too badly rusted.

LIGHTNING GRIP VISE.

If a mechanic could figure up all the time he has wasted in his life in needless tightening and releasing a vise, and reduce the number of hours to dollars and cents, the result would not fail to astonish him.

A recent invention enables the workman to set the vise by a single movement of the handle. Ten seconds is sufficient to make a perfect clamp on each of three pieces, say, 2 inches, 6 inches and 12 inches in



Upper—Wood-Working Vise
Lower—Vise for Iron Work

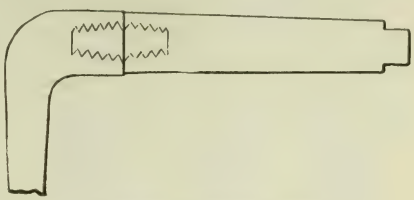
thickness. This shows the range of work. The same principle is applied to vises for holding iron work.

To prevent polished tools from rusting, dip them in boiled linseed oil and allow it to dry on them. Common sperm oil will prevent them from rusting for a short period.

HOW TO REPAIR A BROKEN AXLE IN AN EMERGENCY.

A broken axle which must be repaired immediately for use over a good stretch of road may be done in the following manner:

Take the two parts to the nearest blacksmith and have a half-inch hole drilled and



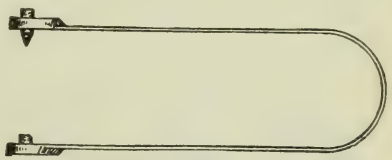
Repairing a Broken Axle

tapped in the center of each piece, then put a half-inch pin, threaded on each end in the two holes, screw together and braze securely.

A correspondent of the American Machinist used this method on an automobile axle which was broken square off next the shoulder for the cone. The auto made a 12-mile run and the repair was entirely satisfactory.

MARKING THE HOLE IN A SLIP LAY.

A very handy tool for marking the hole in the landside point of a slip lay can be made of flat spring steel, light enough to spring with the hand, says a correspondent of the American Blacksmith. The blunt plug should be ⅜ inch and the sharp one should be hardened like a center punch. To



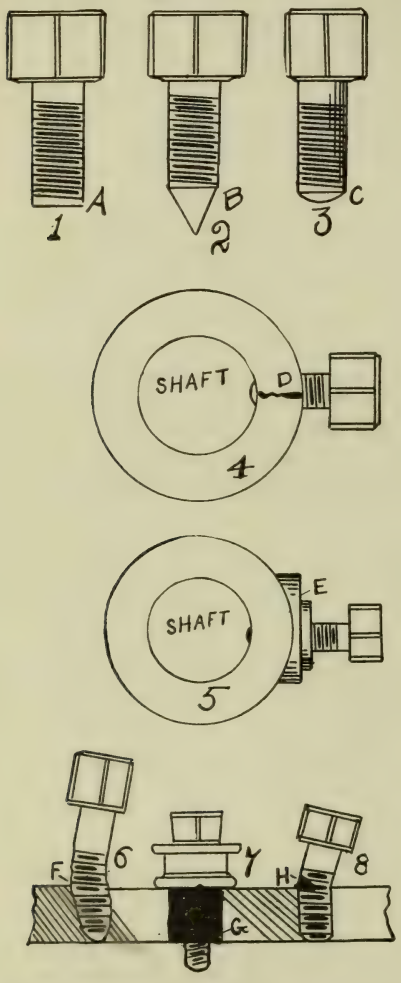
Tool for Marking the Hole in a Slip Lay.

use, hang up the plow by the clevis. Place lay in position and blunt plug in hole in the frog of plow. Spring together with left hand. Hit a tap with hammer on center punch and your lay is marked on the outside and in the right place.

An effective cooling compound for a hot bearing consists of 1 part white lead and 2 parts tallow, mixed with enough cylinder oil to allow it to be fed readily.

SHOP TALKS ON SET SCREWS.

The little problem of set screws as used in modern machinery and devices forms a project of considerable importance. The accompanying sketches will assist in bringing out the desired points. In Fig. 1 we show the "flat-pointed" set screw. This form of set screw may be found in general service very frequently. The trouble with this type



of set screw is that there is no opportunity for the end of the screw to secure a grip equal to that of the beveled point. The blunt or flat-pointed screw is brought to bear upon the surface of the part forming the shaft, wheel or coupling combination, and it may or it may not sustain the parts. I have met with cases in which the pressure of the flat end, A, on the interlof shaft or other part served to hold the part firmly. Again I have found numerous indications of severe grooving, due to the point of the screw having been dragged around the shaft a number of times. To tighten the screw in the groove the screw is given additional turns from time to time. By and by quite a deep groove results, and the shaft will be ruined. Once the groove is established, the parts cannot be moved to right or left unless sufficient distance to prevent any liability of the set screw tip dropping over into the groove.

On the other hand, we have the extremely pointed set screw to deal with, as represented in Fig. 2. The point, B, is hardened, and as a rule quite sharp, so that a hole is soon "pricked." The point serves to afford an excellent gripping power. But when once the hole is formed in the shaft, adjusting is difficult, for the reason that the point of the set screw will work its way into the old hole. Therefore the set screw with the rounded end is usually employed. The oval end, C, can be brought upon the shaft with considerable pressure without actually indenting it.

Some builders of machinery make an excellent design of screw which is about midway between the round end and the pointed end.

The Expansive Set Screw.

One finds set screws in service under varying conditions when he makes a casual examination of machines and shafting in mills, shops and power-using plants. Fig. 4 is a sketch made by the writer of a condition found prevailing in a number of collars used in an electrical power plant. The visit was made through the works during the noon-hour stop. There were a number of collars used on either side of shaft journals for the purpose of retaining the alignment. The collars were not provided with shoulders for the strengthening of the same. Therefore, a number of the collars were fractured, as at D, Fig. 4. In some cases the defect had been overcome by the shrinking of a band of wrought iron about the collars. In other cases the collars were permitted to remain cracked. Fig. 5 is an illustration of one of the collars provided with the strengthening shoulder, as at E. I found that in some cases the fracture in the collars was due to the over pressure of the set screw point upon the shaft. In other instances the use of set screws possessing a tapering condition brought about the split. If the screw tapers, the deeper it is inserted the more liable the expansion is to crack

the collar, and these conditions prevailed in some of the broken collars.

The Lengthy Set Screw Is an Annoyance.

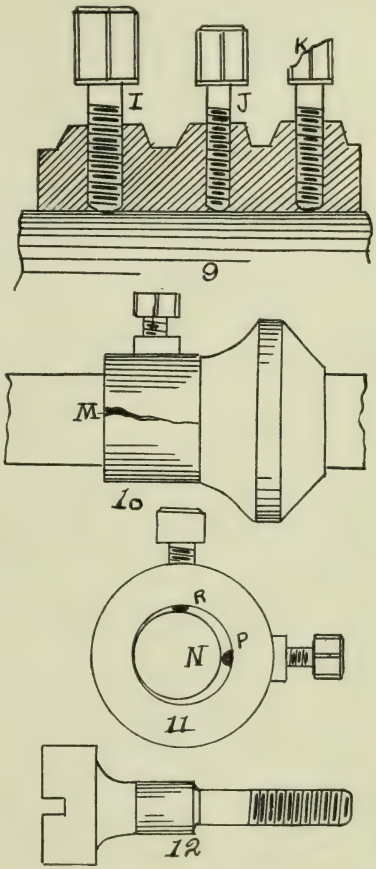
There is always considerable annoyance experienced when set screws are used which are too long. The set screw of unnecessary length in collars is liable to catch upon the clothing of workers and do damage. The long set screw is more likely to become bent than the short or properly adjusted screw. Fig. 6 is an illustration of the set screw of extreme proportions. Because of the projecting upper part, the screw often gets bent, as at F, and a new screw will have to be substituted.

In passing through a flour mill recently I saw that they had made up for the extreme length of some of the set screws in shaft collars and hubs of wheels by using washers as in Fig. 7. The washer system is a poor one. Often instead of washers there are some unusual parts employed to fill the space, as is shown. Sometimes when the thread work of the set screw is exhausted through wear and tear, the hole is bored out and a thimble, G, is substituted. This thimble is cut with the threads to correspond with the threads of the set screw. The thimble is brazed into the part where it belongs and becomes quite as strong as the original solid portion. Fractured portions of set screws, with the defective part at the edge of the bore, as at H, Fig. 8, are not uncommon. I located a number of instances in which the set screws had come into contact with some object and were partly bent over and turned off. When the set screw gets into this condition the only remedy consists in substituting a new one. In many cases the attempt to turn the set screw out will wreck the screw and snap off the head. Then it will be necessary to drill the stub out of the hole, or a cold chisel may be used to cut a slot, and then the stub can be turned out.

Diameters of Set Screws.

We next refer to the diameters of set screws as they were seen by your correspondent. In Fig. 9, at I, is shown the set screw of fair or medium diameter, as employed in usual cases. If one were to look through the shops and mills he would soon locate instances in which there were set screws in use of much greater diameter than needed. The over-weighted set screw is liable to bulge the part into which it has been inserted and fracture the metal. On the other hand, one sees very slender set screws in use at times, one of which we show at J. These styles of set screws are devoid of the substantial bodywork needed to make a firm screw. The happy medium is what the machinist seeks for.

The long, slender set screws are dangerous. They are likewise much bother. It is frequently difficult to keep the thread plan correct. In the same cut we show the broken or worn-headed set screw, and these may be found in some of our best shops. The monkey-wrench in the hands of the new man often causes defects of this nature. Sometimes the edge of the head is worn off.



The defective part is designated I, and the remedy is a new set screw.

Excessive Pressure and Results.

Many times split hubs of gears and wheels are cracked in power plants because of unnecessary pressure of the set screw. Fig. 10 explains the point in mind. The set screw is fitted into the shouldered portion of the hub. Perhaps the set screw point is adjusted into a depression in the shaft.

An unusual strain draws the part over and the point of the set screw rides the common level of the surface shaft. The result is that the set screw is forced outward, often to the degree of opening the hub, as at M. This is fixed in some cases by the use of metal bands about the fracture.

Alignments by Means of Set Screw Points.

It is not out of the ordinary to find samples of crude work with set screws as represented in Fig. 11. I have often met with examples of setting with set screws like this, in which the shaft is of too small diameter for the collar or hub. The workman tries to overcome the trouble by adjusting inward on the set screws. The chances are that the shaft, N, will be thrown quite far out of line, unless there are an equal number of set screws. In the case shown the set screws are two in number and so set that the points, R and P, force the shaft off from the center of the bore. Sometimes the shaft is held in the center by using strips of metal as keys on the side opposite the set screws.

This is a slip-shod way of doing work. A better way is to insert a sleeve. The only proper way is to remodel the parts and adjust them only when the collar fits snugly to the shaft. Fig. 12 is a set screw arranged for turning with the screw-driver blade and monkey-wrench as well. It is seldom possible to get a good grip with the screw-driver. Still there are numerous set screws employed which are manipulated entirely by the screw-driver. "TRAVELER."

HOW TO WEIGH IRREGULAR CASTINGS.

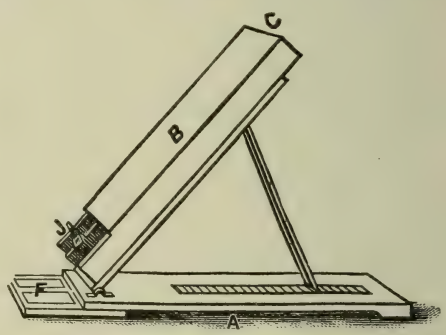
Irregular shaped anchor patterns can be made the right size so that the castings will be of the weight desired after the method shown in the illustration. Of course many know that a cubic inch of iron weighs .26 pounds, says the Pattern Maker, and if the volume of any piece is known the rest of the matter is easy. But irregular shapes are often difficult to figure. Immerse the pattern in water until the pail is just full, then remove it and measure the depth of the water below the top of the pail. Multiplying this distance by the area of the pail gives the volume of water displaced. It is obvious that the volume of the water displaced is equal to the volume of the pattern. This method is applicable to any irregular patterns. Where there are cores which are symmetrical it is easy to figure their volumes and deduct them from the volume of the water displaced.

TELEPHONED FROM A RAFT IN A WATER TOWER.

The inside of a large standpipe belonging to the water company at Paducah, Ky., was painted recently, the painters doing their work from a raft which floated upon the water within the pipe. In all previous times staging had been used within the pipe, but this time the staging was done away with, and telephonic connection was established between the men in the pipe and the engineer in the pump room. When the men had painted as high as they could, they signaled the engineer, who raised the level of the water in the pipe to the required height, and the men proceeded with the work.

THE TINTOMETER.

The tintometer, devised by J. W. Lovibond, of Salisbury, England, is an instrument by means of which the color of any



The Tintometer

object, liquid or solid, opaque, translucent or transparent, can be measured and analyzed in such a way as to permit the keeping of a simple and easily understood record; and for facilitating the establishment of color standards and promoting adherence to them.

A set of standardized colored glasses is used in making the tests. The standard glass is placed at J, and the object tested at F. The observer looks into the box (B) at C.

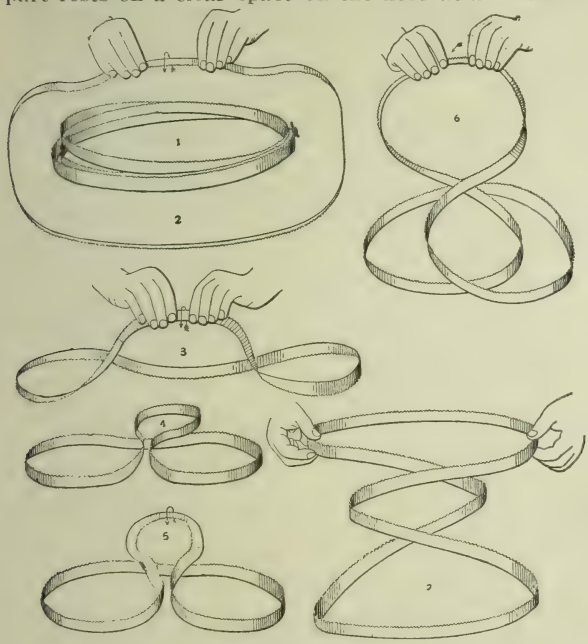
HACK-SAW WRINKLE.

The following is a very expeditious method to obtain a wide slot in a minimum of time: Instead of using one saw blade in the frame, simply add more blades, according to the width of the slot required. This will be found to save much tedious labor of filing.

HOW TO FOLD A BAND SAW.

The proper method of folding a band saw is not easy to discover without help, but by means of a practical demonstration is very quickly learned, says a correspondent of the American Machinist, who proceeds to explain just how it should be done, as follows:

Fig. 1 shows a saw which has been folded as required. Fig. 2 shows the beginning of the operation with the saw open and in position for making the first twist. The lower part rests on a clear space on the floor at a convenient distance in front of the operator, who stands holding the upper part as shown by the hands. It will be noticed in Fig. 1 that there are three folds, and that of course they cannot lie level all around as a broken saw can be rolled. In Fig. 2 the saw is twisted in the direction of the arrow, and it will be noticed in all the views that the twist is always in the same direction. Supposing the saw to be held with the teeth away from the operator, the first twist turns the part in the vicinity of the hands with the teeth toward him. If the entire saw is allowed to spring freely while twisted in this way, this has the effect of throwing the lower part of the saw into two loops, as shown in Fig. 3, although Fig. 3 really goes a step beyond this stage and shows the next twist commencing. Fig. 4 shows that the effect of the first twist can be very simply obtained by merely laying the saw on the floor and drawing one part over the other; but nevertheless in folding a saw it is easier to obtain this effect by a twist, as in Figs. 2 and 3. Fig. 5 shows how the saw is to be twisted after it has assumed the Fig. 4 position. This final twist when completed allows the saw to fall easily into three coils. The first two loops form two coils which turn one over the other when the third is formed. The third coil is formed as soon as the remaining part of the saw is twisted completely over. The rings then will adjust themselves and will not open again unless untwisted. Untwisting can very easily be done by anyone, although it is seldom that a person can discover by carefully opening a saw how to fold it again.



Folding a Band Saw

Fig. 6 shows the operation practically completed. The two lower loops are overlapping each other with their teeth uppermost, and the upper loop still has its teeth toward the operator and merely requires to have them turned upward and the loop allowed to fall and adjust itself with the other two. Fig. 7 shows the saw completely folded, but with its coils raised vertically to show how they lie.

Saws in use can be handled and stored much more conveniently when folded in this way than if they are kept at their full diameter. A broken saw can easily be rolled up and tied by anyone, but an endless saw cannot be rolled, and there are many workmen who only know how to manage a broken one.

POLISH FOR HARDWOOD FLOORS.

A fine wax polish for hardwood floors may be made as follows: One-fourth pound of potash mixed with equal weight of water, boil and add gradually, stirring all the while, one-half pound of yellow bees-wax. Boil up, then pour in one pint of water and heat till it looks milky. Apply at once.

To find the thickness of lead pipe required when the head of water is given, multiply the head in feet by size of pipe wanted, expressed decimally, and divide by 750. The quotient will give thickness required in hundredths of an inch.

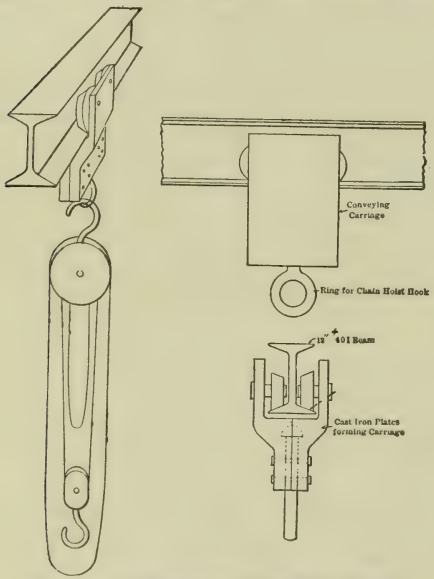
AN EXCELLENT VARNISH FOR IRON WORK.

Dissolve ½ pound of asphaltum and ½ pound of pounded resin in 2 pounds of tar oil. Mix hot in an iron kettle, but do not allow it to come in contact with the fire. It may be used as soon as cold, and is good both for outdoor woodwork and ironwork.

HOW TO MAKE A TRAVELING CRANE.

An inexpensive and very satisfactory traveling crane for the plant where there is a great deal of heavy lifting in connection with repair work, etc., may be made at home, says the Street Railway Review.

Make of 8x10-inch pine timbers two A-frames to fit singly into an extra heavy 12-inch I-beam. (See sketch). Pass bolts through both timbers above and below the I-beam and fasten substantial cross pieces diagonally across the two legs. Notch out a



Details of a Home-Made Traveling Crane.

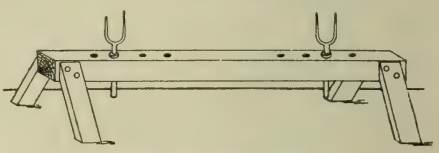
heavy timber near each end to keep the legs from spreading and run bolts through the ends of the bottom beam to prevent shearing of the end pieces. Make a carriage of four wheels with faces beveled off to fit the flange of the I-beam, which will distribute the weight carried over the face of the flanges. The hook is below the I-beam and has two stiff cast-iron plates running up to carry the pins in which the wheels revolve.

Fasten a heavy chain block into the hook and the arrangement, which will pick up any ordinary weight, is complete and by means of it a piece of apparatus can be picked up and moved from 15 to 18 feet along the length of the I-beam in a very short time.

Four men can set up such a crane in a half day and when it is not in use it can be taken apart and stored. Its cost would be approximately $150; a 20-foot, 12-inch I-beam, weighing 40 pounds per foot costing $24; carriage can be built at machine shop for $30 and a 5-ton hoist of 12 feet lift would cost about $85.

A HANDY TRESTLE FOR THE REPAIR SHOP.

A handy device to keep a buggy tongue or shafts from slipping off the trestle while ironing or repairing is described by a correspondent of the American Blacksmith. A number of holes are bored in the trestle to receive a Y-shaped iron piece made with a ⅝-inch stem and ½-inch branches and hav-



Trestle for Repair Shop.

g a collar welded to the stem 2 inches from the crotch. The device is so simple and saves so much annoyance that it is well worth the making.

TEMPERING SPRINGS.

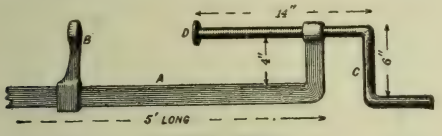
Fish or bank oil bites best in tempering springs. It gives sharper temper than black oil or cotton-seed oil. When using fish oil springs will stand up better if a shade less heat is used for tempering, than when using black oil.

A HANDY CLAMP FOR ANY PURPOSE.

A handy clamp for clamping wagon-box bottoms, doors and, in short, can be used for any purpose where clamping is to be done and can be made any length, says a correspondent of the Blacksmith and Wheelwright, is made as follows:

A is a bar of iron, 1½x1½ inches by 5 feet long, and eye turned and welded at one end. Four inches from the eye the bar is turned at right angles, edgewise. B is made of ⅜x1½-inch iron, and made to slide and stop anywhere on A. C is a crank of ¾-inch rod iron, 6 inches crank and 14 inches straight.

The straight part is threaded and works in the eye of A, which is also threaded. D is a washer that is fitted on C by a shoulder being filed for the washer to work against.



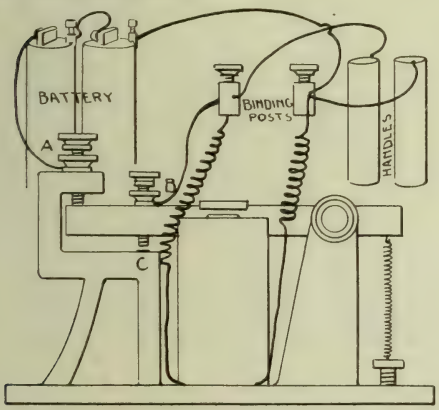
A Handy Clamp

The end of the rod is riveted so as to hold the washer, D. No notches are needed in the bar A to hold B; it will not slip when weight comes upon it, but will hold the firmer.

HOW TO MAKE A SHOCKING MACHINE.

A good shocking machine may be made out of a telegraph instrument as follows:

Fasten one of the battery wires on one of the binding posts of the instrument and fasten the other wire on the regulating screw, A; connect B with the other binding post. To prevent contact when the armature is pulled down put a piece of paper or thin rubber under the regulating screw, B, at C. The armature acts as a contact breaker as on the induction coil. In order to feel the shock, fasten two handles on the binding posts. The shock is regulated by the regulating screw, A.



Shocking Machine

Wm. J. Slattery, of Emsworth, Pa., who sends in this shop note, says an instrument of this kind will give a stronger shock than many high-priced medical coils.

Our readers are invited to contribute to this department. We can use rough pencil sketches; our artist will fix them up properly, and the editors will do the rest.

THE BLACKSMITH AND POWER-DRIVEN MACHINERY.

How to Measure the Difference in Expended Energy in Operating Hand Tools and Power-Driven Machinery

Nowadays there are two classes of blacksmiths, each having a distinct and widely different motive in its calling. We do not speak of the blacksmith who uses power-driven machinery and the blacksmith who does not, though truly a distinction could be drawn there by naming the one as out-of-date and the other as modern. But here the

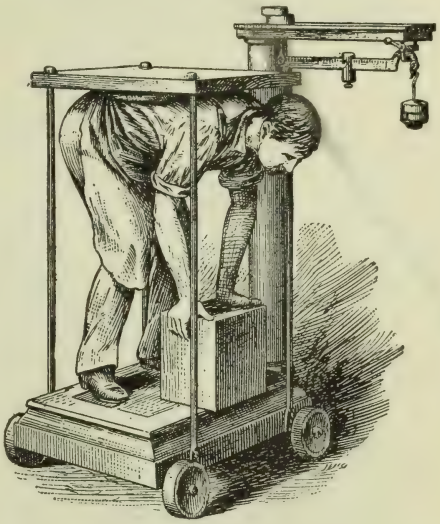


Fig. 1. How Much Can You Lift?

classes referred to are composed of the time-honored smith, fabled in song and story as honest and brawny, who blacksmiths to earn his daily bread, and that growing class of men of many crafts and professions who have taken up blacksmithing from pure love of the work and of mechanics in general. The smith of this class may be honest or not as it happens and his muscles may be as flabby as an infant's, but according to tradition the strenuous recreation should rectify any fault in either direction, and surely for developing the strength no young man could choose a better form of athletics; foot-ball, tennis, rowing, hunting, none of the popular sports are to be compared to it. Until the end of time there will be something sociable and alluring about the blazing forge and the clanging hammers.

Blacksmiths who come within this latter class and who are usually amateurs should by all means learn to handle the hand tools

well in order to carry out their purpose and should install power-driven machinery only after the hand tools can be managed perfectly. Many power-driven machines, however, are to be found in the little backyard shops where amateurs practice the craft at night after a long day in the office and in the shop where the farmer-smith likes to do his own repairing. But the blacksmith who depends upon this work for bread and goes

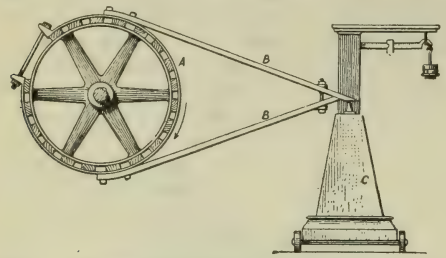


Fig. 2. Brake or Dynamometer for Weighing Friction

on day after day depending only on the results of hand tools when by means of power-driven machinery he might accomplish many times the results is very much like the man who hid his talent and from whom all was taken away.

In either case the following tests given by the Blacksmith and Wheelwright will be interesting. To the amateur because they will give him a fair idea of what he can do and to the behind-the-times smith in that they will demonstrate how much is to be gained by the use of power.

Fig. 1 is an apparatus composed of a small portable scale. The top frame is secured by rods imbedded in the sides of the scale. By means of this scale a smith can easily ascertain how much he can lift. To do this he crouches on the platform with his back against the frame and his arms resting upon a block. Supposing that the hand block and the frame together weigh 15 pounds and that the blacksmith's weight is 175 pounds the scale arm will indicate 190 pounds. By the smith's pressing upward against the frame with his back the number of pounds indicated is increased and this increase is the weight he can lift. The experiment may be carried further by setting a number of pounds to be lifted in a given time and practicing until the object is accomplished. Were the smith to keep up this test for two hours at a time, at the end of that period he would find that his weight had decreased several pounds. This difference in weight is the actual measurement of the energy he expends in that amount of work and measurements made in this way give some startling figures. Surplus energy is foolishly expended by the man who could utilize machinery driven by a gas engine or other power to do much more work in a shorter time with

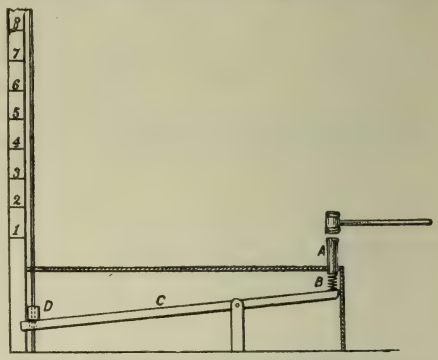


Fig. 3. Striking Box for Testing Force of Blow

a much smaller expenditure of energy, and at the end of the day he would be able to go home in a less irritable frame of mind.

In Fig. 2, is shown a brake or dynamometer for weighing the friction of work done by hand or by machinery. It consists of a metal band, A, clamped around the pulley of a machine by means of a bolt and nut.

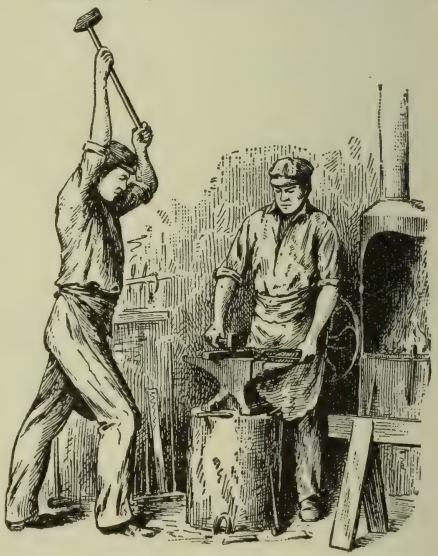


Fig. 4. The Force of the Blow Depends on How the Sledge is Grasped

Between the band and the pulley are placed wooden blocks. Arms, B, B, are fastened to the metal band at one end and bolted together near the other end which rests upon a scale block, C, and depresses it, thus weighing the friction. By multiplying the scale weight so found by the circumference in feet of a circle having a radius equal to the length of B and then by the number of revolutions made by the pulleys the

foot-pounds of work can be computed. Attach such a brake to a grindstone with the helper turning the crank and weigh the friction. Compare the results.

Fig. 3 is an excellent device for testing the force of a blow. A scale is marked off to show the height to which the dummy, D, is forced by a blow. The stake, A, is struck with a sledge, the blow depresses the spring, B, which operates the lever, C, by which the dummy is forced toward the top of the rack.

The force of a blow from a sledge or hammer (Fig. 4) depends upon the way the handle is grasped and how it is swung and also upon the weight of the hammer, the squareness of the blow, the strength of the helper, etc., and these little points are important to both the amateur and the experienced smith, but for the latter it is false economy to go on using the sledge which requires the hiring of a helper and is slow and in the outcome expensive. A trip-hammer should be installed in every blacksmith shop. It does the work rapidly, pounds regularly, incessantly and hard, and a single helper can handle a large amount of work on it while an increase in earnings will soon become apparent. The power required to operate steam hammers is about one horsepower for every 100 pounds of falling weight. They are rated by the weight of die, ram, rod and piston. Trip-hammers are rated by the weight of the head, as: 25-pound head, 75-pound head.

Tests of the power of a team of horses as pitted against the number of horsepower of an engine are very interesting. The unit of power, or 33,000 foot-pounds per minute is usually greater than good draught horses can do. By means of a dynamometer the exact power of a team of horses may be measured. The dynamometer, (Fig. 5) comprises a spring, A A, with a needle, B, and a graduated scale, C. D is a strip of paper ruled to correspond with the scale and is caused to move under the needle at a uniform rate by means of rollers which are moved by a train of gearing, the whole being enclosed in a box beneath the scale.

In tests made with a draught horse drawing a cart and walking, it was shown to do 25,920 foot-pounds of work per minute, 7,080 foot-pounds less than the accepted unit of horsepower. This is an average result under favorable conditions, for, of course, resistance varies with the character of the road.

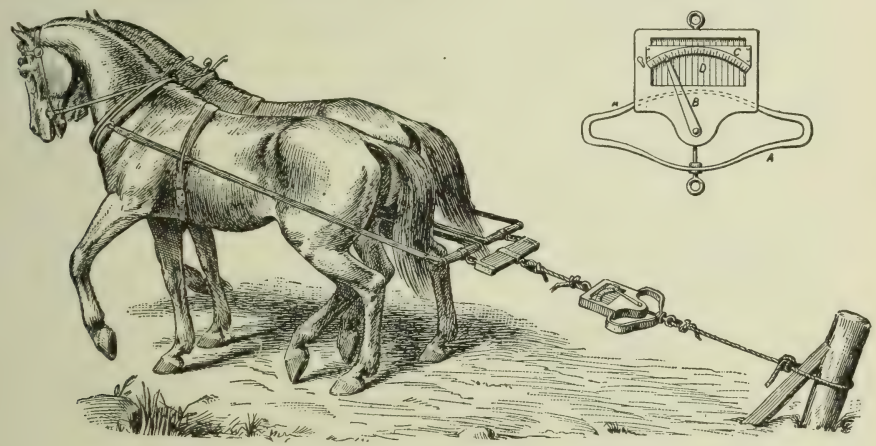


Fig. 5. Testing a Team by Means of a Dynamometer.

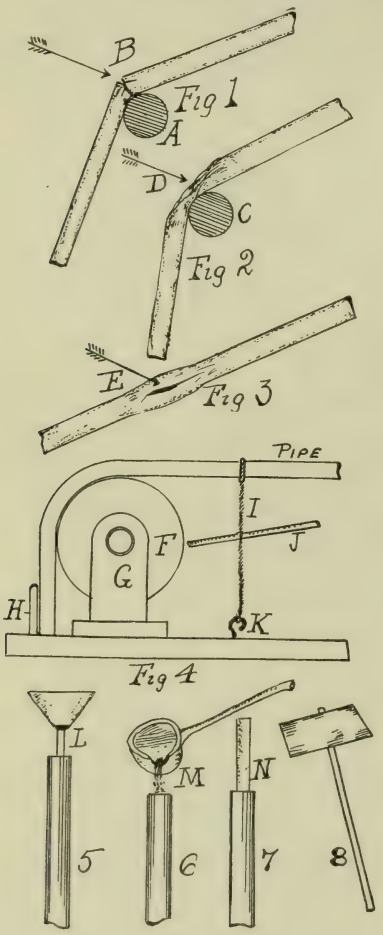
With these figures before us it is not difficult to believe that mechanical power will in time wholly usurp physical power in such cases as those under discussion. The illustrations are by courtesy of The Blacksmith and Wheelwright.

SUBMARINE SINKS CRUISER.

The submarine torpedo boat "Shark," commanded by Lieut. Charles P. Nelson, recently sank the cruiser "Columbia" of the North Atlantic training school—technically. The "Columbia," "Minneapolis" and "Prairie." were engaged in target practice at No Man's Land when their officers were apprised that an attack was to be made upon them by torpedo boats. The "Shark" succeeded in getting within 50 or 60 yards of the "Columbia" and thus technically sank that cruiser.

HOW TO BEND PIPES.

The process of pipe bending is not difficult when the right way is undertaken. If some other than the proper way is adopted, the chances are that the walls of the pipe will collapse, or the sides will be cracked or fractured. Split pipe, due to an attempt to make a bend in its course, is common. One may find samples of defective work of this nature in any shop and oftentimes in



the house. The accompanying illustrations will assist the novice in pipe bending. The usual method of making a bend is to work the pipe to the required oval shape over an object. Sometimes that object is the vise, or anvil, or it may be a round piece of metal or wood set up as shown in Fig. 1 at A. In making the bend over this object the chances are that the pipe will be broken off as at B, if sufficient pressure is applied, or the pipe shell may collapse as at D, Fig. 2; the mandrel is indicated at C. Again, we find that in many instances in pipe bending, the pipe shell is split open as at E, Fig. 3.

To avoid troubles of this kind and to preserve the original strength of the pipe, the best way is to make some forms over which to effect the bending. The process of "filling" or "packing" the pipe hollows first is adopted. One of the pipe bending forms of a rotating order is shown at Fig. 4. It is very easily constructed at slight expense. A platform of wood, about 3 feet long and 1 foot wide, is secured, to which is attached the stand, G, for bearing the bending disk, F. This disk is of hard wood, usually about 4 inches thick and 20 inches in diameter. A shaft made of wood is put through to sustain the wheel in the proper position and a bearing of the wooden stand is used for either side. The wheel or bending disk is therefore well sustained and is strong. There is a "check" pin at H, back of which the pipe to be bent is adjusted.

The "packed" pipe end is dropped back of this checking block and muscular power used to draw the pipe form back and down over the disk. In order to assist in the work, a strong metal hook is screwed into the wooden platform at K, and a cord, I, is connected with the hook and the pipe in process of bending. There is a "twisting" bar of wood, J, inserted into the twist of the cord and the bar can be turned and the pipe drawn down to a fuller degree.

Pipe Packing.

To try to bend the pipe cold on these forms or any other would almost invariably result in the breaking of the pipe walls, making it necessary to restore the walls or patch them. To overcome this danger the process of packing the interior of the walls with materials is adopted. Figure 5 illustrates the mode of pouring molten rosin into a pipe. The pipe is placed in an upright position and the lower end is plugged with a wooden plug or with clay. The tunnel, L, is adjusted into the pipe opening and the molten substance is poured therein. The process is simple. By this means the pipe becomes quite solid, due to the rosin hardening inside, and the bending can then be brought about without any likelihood of the walls collapsing. To get rid of the rosin afterwards is easy, as a slight heating will cause it to melt and run out of the pipe. It can be used again if desired.

Another method of pouring the rosin is

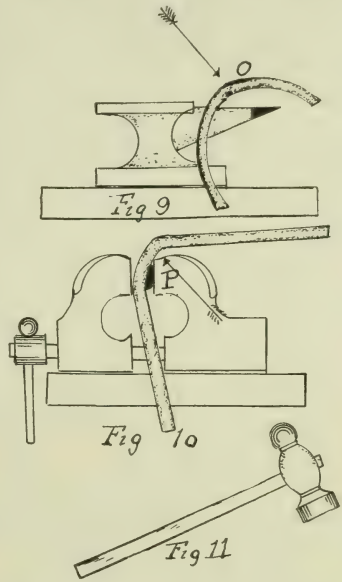
shown at Fig. 6, in which a common pouring ladle, M, is utilized, and the stuff is poured direct, instead of through a tunnel. When the clay-packing is used, the process is as in Fig. 7. Clay of ordinary character is selected, and lumps removed by the usual puddling and rolling. Then when the clay is in a putty-like condition, it is forced into the pipe channel. The packing is done by using a common wooden plunger, N. The plunger can be driven home by force or by using a mallet. The kind of mallet usually employed is shown at Fig. 8, although any sort of mallet would answer.

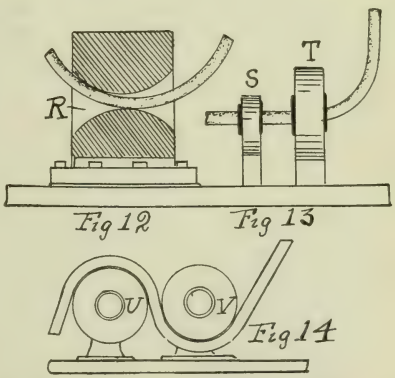
Different Forms of Bending.

The average man prefers to bend the piping by making use of the devices at hand. There is always considerable bother attached when it is necessary to construct special forms for bending. Often the forms are used only a few times. Therefore a goodly proportion of the bending of pipes in shops, workrooms, homes and other places is done by resorting to the vise or the handy anvil. In Fig. 9 we illustrate the process of working the packed cold pipe over the anvil. Of course if the pipe were heavy, or the metal thick, this could not be done, but ordinary piping can be bent in this form without much difficulty. After the filling of the pipe is accomplished, the pipe is grasped with a hand at either end and the ends pressed down with the anvil as the center point. In order to assist in getting the properly described circle, the common machinist's metal hammer with bell head is used. The strokes are applied at the point O, and the left hand holds the base end of the pipe. In this way the pipe can be brought to a prescribed circle without fracturing the metal. If the vise is used, there is danger of making abrupt turns, as in Fig. 10, unless precautions be taken to avoid this trouble. The grip is usually made on the loaded pipe and then the bend is attempted by forcing with the hands. I would first make forms for the vise, so that the forms can be closed in on the pipe and protect it. Then the proper bends can be made without danger of depressing the shell. The bell hammer is also used in this work. One of the handy styles of hammers is shown in Fig. 11. This is the common machinist's type and can be purchased at any of the hardware stores. It is a mistake to attempt to get the desired bends in the pipe with the claw hammer. A mallet may be used to some advantage and without danger of injuring the metal pipe shell.

A Handy Form for Quick, Light Bending.

It frequently happens that there are light pipes to be bent on which it is not desired to spend much time. Figure 12 is a drawing of a form which is readily made for this purpose. Get a block of seasoned hard wood, about 6 inches long and same size in height and breadth. Take it to a woodworking establishment and have it bored through, say with a 2-inch bit. Then have the hole tapered from the center on





either side. This gives it the shape shown in the sectional drawing of the block at R, Fig. 12. The block is then screwed or bolted to the base block and it can be used for the purpose of bending pipe in various directions.

Another little scheme that is simple and handy is shown in Fig. 13. There is a base piece used for a platform and to this base

is mortised the stands T and S. These stands are pieces of hard wood, of sufficient strength to carry metal sleeves. The sleeves are simply sections of metal cut from pieces of pipe the next size larger in diameter than any pipe calculated to be bent in the form. The pipe for bending can be inserted through the holes as illustrated and, by using force, the pipe can be bent to desired angles. The serial roller system of pipe bending on the bench of the workshop by hand is shown in Fig. 14. This consists in having two, three, four or more disks. U and V, set up on wheel pins or studs. The latter are fixed to proper stands and the stands fit firmly into a foundation plank. Only the lighter forms of pipes can be bent in these contrivances. The work involves the application of muscular power and considerable tapping with a wooden mallet. The object is to get the pipe in prescribed circles about the forms as shown. The form is of service when it is desired to get

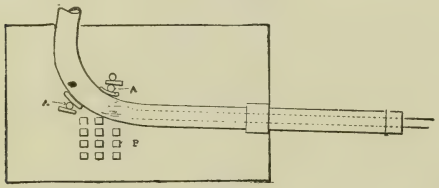


Fig. 15

piping adjusted in forms kindred to the letter S.

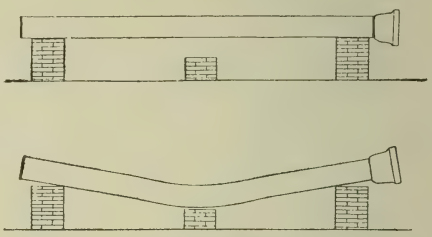
Bending Large Pipe.

The method of bending large wrought-iron pipe up to a diameter of 8 inches and to a circle of 5 feet radius illustrated at Fig. 15 is given by a correspondent of the American Machinist:

A templet of about ⅛x1-inch stock is first made by the blacksmith. The pipe to be bent is laid on a table of gray iron having tapering holes, B, about 1¼ inches square over the entire surface to receive bars about a foot long. It is evident that by placing the pipe between two such bars as per sketch and putting a strain on the end of the pipe that the pipe will bend. It is well to reinforce the bars as shown. The method of heating the pipe is perhaps the best feature of the job. What is really a large blow pipe is made of two concentric pipes, natural gas being the fuel and a blower from a blacksmith's fire furnishing the air. By means of a simple arrangement of fittings, including some rubber hose, it was made so that the flame could be turned on any part of the pipe to be bent. The flame was, of course, inside the pipe to be heated. By this method a good, smooth job can be done. I might also mention the pieces marked A in the sketch are used to prevent the pipe being marred.

BENDING CAST-IRON PIPE.

One rarely has occasion to bend cast-iron pipe, but if only straight pipe were on hand and a curve were to be turned, it would be somewhat of a problem to bend the pipe. A correspondent to the Journal of Electricity, Power and Gas tells a simple method he has of bending the pipe. Two or more pipes are placed on piers in the forge, as



Bending the Pipe

shown in the sketch, the central pier being shorter than the end piers according to the angle of the curve to be turned. The fire is then built up around the pipes until they warp down in the center and touch the central pier wall. The fire is then knocked out, no water being used to extinguish it. Good bends may be made in this way in pipe that must bear a high pressure. The wood is piled after the manner that a blacksmith heats his tires.

HOW TO TEMPER A BUTCHER KNIFE.

The following simple method of tempering a butcher knife is given by a correspondent of the Blacksmith and Wheelwright:

Make a small box, say 4x4, or 4x6, and

To Temper a Butcher Knife

about 18 or 20 inches long, leaving one end open. Fill it with stone coal ashes, the finer the ashes the better. Wet the entire contents of the box with clear cold water. When your knife is ready to temper, heat to a cherry red and thrust into the wet ashes and let it remain until cold. It will come out good metal from hilt to point and from edge to back.

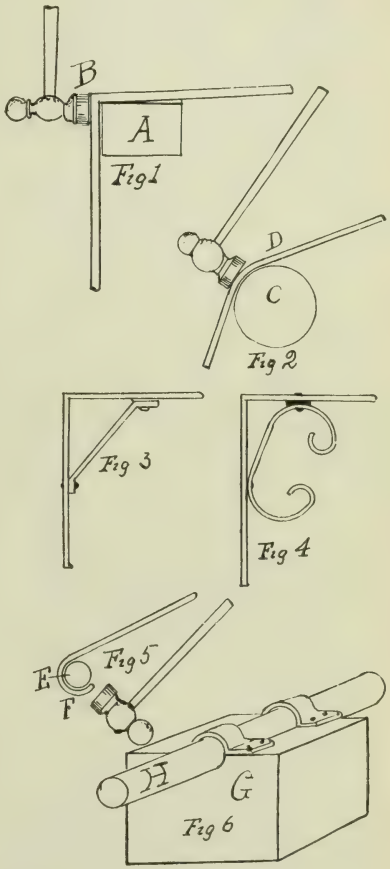
MECHANICS FOR YOUNG AMERICA

SOMETHING FOR BOYS TO MAKE.

Many an industrious lad has made money manufacturing the common forms of wood brackets, shelves, boxes, stands, etc., but the day of the scroll saw and the cigar-box wood bracket and picture frame has given way to the more advanced and more profitable work of metal construction. Metal brackets, stands for lamps, gates, parts of artistic fences for gardens, supporting arms for signs, etc., are among the articles of modern times that come under the head of things possible to construct of iron in the back room or attic shop. The accompanying sketches present some of the articles possible to manufacture.

First, it is essential that a light room be available, or a portion of the cellar where there is light, or a workshop may be built in the yard. Buy a moderate sized anvil, a vise and a few other tools, including bell hammer and this is all required for cold bending. If you go into a forge for hot bending, other devices will be needed. Figure 1 shows how to make the square bend, getting the shoulder even. The strip metal is secured at the hardware shop or the iron works. Often the strips can be secured at low cost at junk dealers. Metal strips about half an inch wide and one-eighth of an inch thick are preferable. The letter A indicates a square section of iron, though an anvil would do, or the base of a section of railroad iron. The bend is worked on the corner as at B, cold. If a rounded bend is desired, the same process is applied on the circular piece of iron. This is shown in Fig. 2 at C. This piece of iron can be purchased at any junk store, where various pieces are always strewn about. A piece about 20 inches long and 4 inches in diameter is handy. The bend in the metal begins at D and is made according to the requirements. Occasionally where sharp bends or abrupt corners are needed, the metal is heated previous to bending.

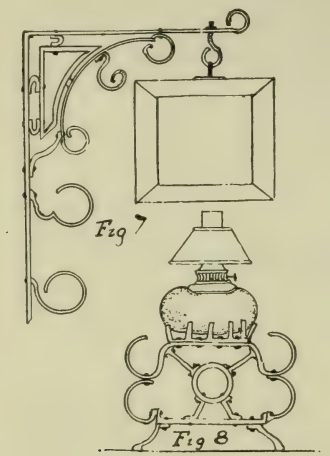
Although the worker may produce various forms of strip-metal work, the bracket is, as a rule, the most profitable to handle. The plain bracket is shown in Fig. 3, and is made by bending the strip at the proper angle on form A, after which the brace is adjusted by means of rivets. A rivet hole boring tool will be needed. A small metal turning or drilling lathe can be purchased for a few dollars and operated by hand for the boring, or a common hand drill can be used. Sometimes the bracket is improved in design by adding a few curves to the end pieces of the brace, making the effect as shown in Fig. 4. After these brackets are made they are coated with asphaltum or Japan; or the brackets may be painted or stained any desired shade.

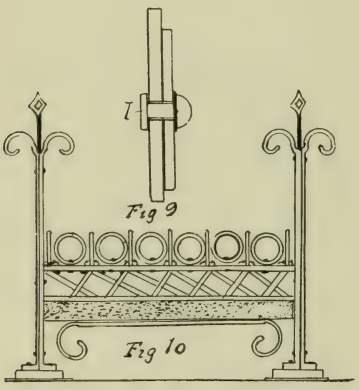


In some of the work required, it is necessary to shape a complete loop or circle at the end of the piece. This may be wrought out as in Fig. 5. The use of a bar of iron or steel is as shown. The bar is usually about 2 inches in diameter and several feet in length so that it will rest firmly on a base

of wood or stone. Then the bending is effected as at F, about the bar E, by repeated blows with the hammer. After a little practice, it is possible to describe almost any kind of a circle with the tools The bar can be bought at an iron dealers for about 40 cents. From the junk pile of junk shop one may get a like bar for a few cents.

A convenient form for shaping strip-metal into pieces required for brackets,





fences, gates, arches, and general trimmings is illustrated at Fig. 6. First there ought to be a base block, G, of hard wood, say about 2 feet square. With a round point or gouging chisel work out the groove to the size of the bar, forming a seat, by sinking the bar, H, one half its depth into the wood as shown. In order to retain the bar securely in position in the groove, there should be two caps fitted over it and set-screwed to the wooden base. These caps may be found in junk dealers' heaps, having been cast off from 2-inch shaft boxes. Or if caps are not available, the caps can be constructed from sheet metal by bending to the form of the bar, allowing side portions or lips for boring, so that the caps can be set-screwed to the wood. Thus we get a tool which can be used on the bench for the purpose of effecting series of bends in strips of metal.

Since the introduction of the laws requiring that signs of certain size and projection be removed from public thoroughfares in cities, there has been quite a call for short sign backets, so termed, of the order exhibited in Fig. 7. These sign-supporting brackets do not extend more than three feet out from the building. A boy can take orders for these signs in almost any city or large town with a little canvassing. The sign supporting bracket shown is merely a suggestion. Other designs may be wrought out in endless variety. A hook or eye is needed to sustain the ring in the sign.

The young man who undertakes to construct any sort of bracket, supports, frames or the like, will find that he will get many orders for lamp-supporting contrivances, such as shown at Fig. 8. It is hardly necessary to go into details for making these stands as every part is bent as described in connection with the bending forms, and the portions are simply riveted at the different junctures. Both iron and copper rivets are used as at I, in Fig. 9, a cross sectional view.

The best way is to bore straight through both pieces and insert the rivet. In some cases the rivet is headed up in the bore and again washers are used and the heading effected on the washer. Copper rivets are soft and easily handled, but are costly as compared with iron rivets.

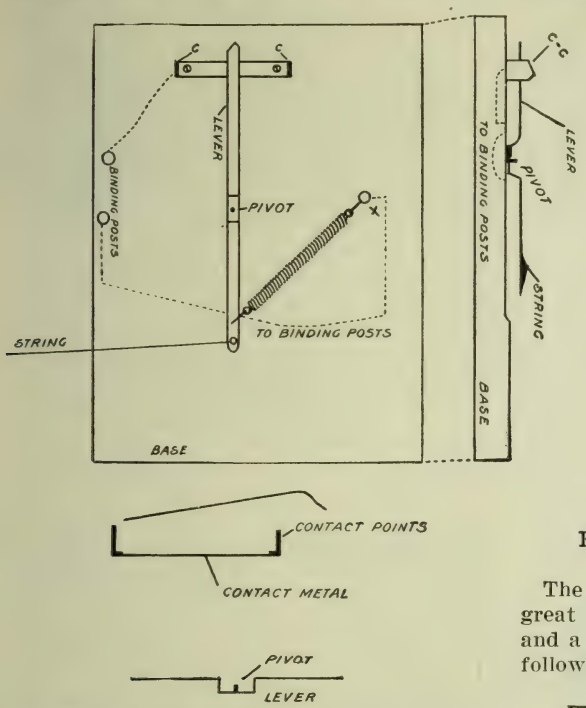
Good prices are obtained for the guards for open fireplaces made in many varieties in these days. The return of the open fireplace in modern houses has created a demand for these guards and in Fig. 10 we show a design for one of them. The posts are made sufficiently stiff by uniting two sides with rivets. The ends at top are looped as shown, while the ends or butts at the base are opened out to make the feet. Rings are shaped on forms and are then riveted to the base cross-piece as illustrated. Crosses are made to describe to central design and the plan is worked out quite readily with the different shapes.

Bologna sausage is now being adulterated with corn meal. The meal is harmless, of course, the imposition consisting in paying 12 cents a pound for meal.

HOW TO MAKE A SIMPLE BURGLAR ALARM.

BY THOMAS M'CALL.

Take a piece of any wood about 6 by 8 inches for the base. This may be finished in any way desired. For the contact points



use brass or any sheet metal which will be satisfactory. Take a piece about 2½ or 3 inches in length and bend the ends up about one-half inch in a vertical position as shown. Fasten this to the top of the board using screws or nails. Under this strip of metal fasten a copper wire which can be connected to a binding post on the board if desired. Take another piece of metal about 4½ inches in length and make a lever of it in the shape shown in the diagram. Fasten this so that one end of it will swing freely, but not loosely between the ends of the other piece marked C-C. Near the end fasten a spiral spring (S) which can be obtained almost anywhere. Fasten the end of this to the screw marked X. Also fasten to this screw a copper wire leading to the binding post. In the lower end of the lever make a small hole to fasten a string to.

This string may be fastened across a door or window and any movement of it will pull it to the contact point on the right. If the string is cut or broken the spring will pull the lever to the contact point on the left and thus complete the circuit.

It may be best to use an automatic circuit closer with this as the contact is liable to be made for only a few seconds. Such a circuit closer was described in Popular Mechanics for May 23, 1903.

If the string is burned it will also act as a fire alarm.

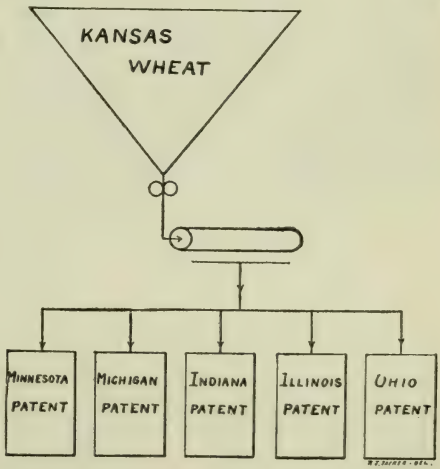
NOVEL CHESS GAME.

Some officers of the U. S. Navy played the most novel game of chess on record not long ago.

The United States cruiser "New York" was cruising down the western coast from San Francisco to Magdalena Bay. Several miles away was the cruiser "Boston." The officers on the two ships engaged in the game of chess by means of wireless telegraphy, making their moves almost precisely as though they had been on the same ship. The players of the "Boston" won the game.

KANSAS WHEAT IN DEMAND.

The grain dealers of Kansas are shipping great quantities of wheat into other states and a prominent milling paper publishes the following cartoon in explanation of where

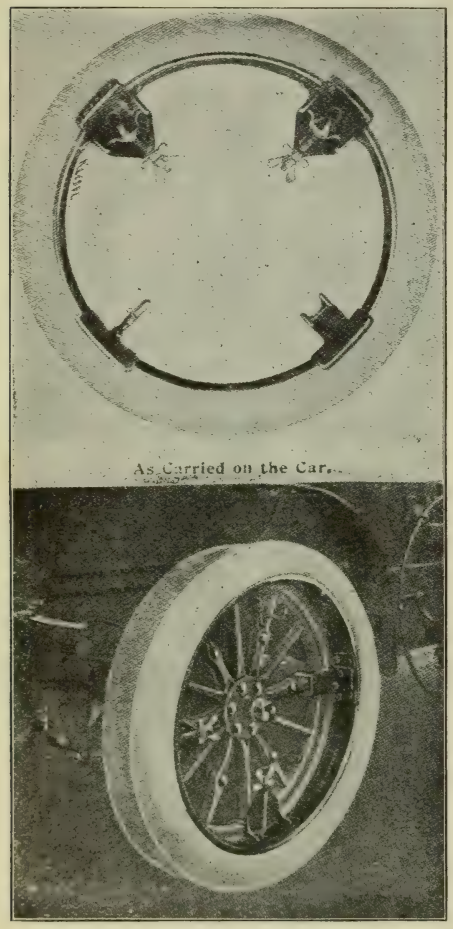


the favorite state brands of flour get their supply.

Mills in practically every state east of the Missouri river are buying Kansas wheat.

EMERGENCY WHEEL FOR AUTOS.

A tire manufacturer in South Wales has devised an emergency wheel which can be applied in a few minutes. The Motor News, Dublin, says:



Attached to the Car

"The wheel is merely a rim on which a tire is kept always inflated. It is fitted with three metal clamps arranged to grip the periphery and spokes of the wheel it is to be attached to, and is held locked by two simple thumb screws. It is easily carried on the step of the car, and in that position is in no sense an encumbrance."

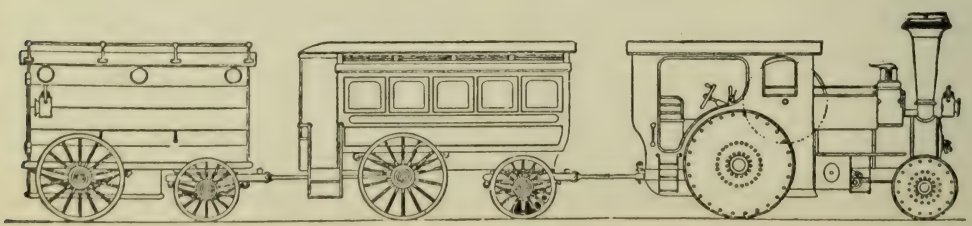
TEST MOTOR CARS FOR SUBURBAN SERVICE.

Motor cars will not be used yet awhile on the Burlington railroad for handling Chicago suburban traffic and on branch lines. A short time ago operating officials of that road tested a gasoline electric motor car in a trial run from Aurora to Chicago and return. The motor was of 225 horsepower operated by electricity generated by a gasoline engine and drew two trailers making at times a speed of 30 miles an hour. The speed is sufficiently high for the service required, but the motor did not work altogether satisfactorily and considerable vibration was caused by two large fly-wheels. The road has not given up the idea, however, but will endeavor to correct the faults.

PROPOSED ROAD LOCOMOTIVE AND TRAIN.

An English engineer of prominence, who is a firm believer in the advantages and future of the road locomotive service, offers a model type which is shown in the cut.

Care has been taken to avoid the usual objection of the road engine, which as at present constructed is liable to frighten horses. In the proposed construction the moving parts of the driving machinery are concealed, and noise reduced to a minimum. The train as suggested contains a passenger car or omnibus mounted on four wheels and seating 20 passengers. The rear trailer is for trunks, express and light freight packages. In France traction engines of this class make eight miles an hour easily, over roads which are both rough and hilly. Such trains are in regular service between Lyons and Grenoble, a distance of 70 miles, the trip being made in the night—one train each way.



I Spend the First Dollar

I will pay for your first bottle of Dr. Shoop's Restorative.

There are no conditions. Nothing to deposit. Nothing to promise. The dollar bottle is free.

Your druggist, on my order, will hand you a full dollar's worth and send me the bill.

I shall spend $100,000—half a million, perhaps,—this season that you may learn how Dr. Shoop's Restorative strengthens the INSIDE nerves—the nerves that control the vital organs. That you may know for yourself, after a fair, free test in your home, that this is something uncommon—something UNUSUAL in medicine. Not a narcotic or a deadening drug—but a strength-building, life-inspiring, tonic that gives lasting power to the very nerves that control the vital processes of life.

Dr. Shoop's Restorative

If the worries of business have left their scars on your good health; if careless habits have made you a wreck; if your nerve, your courage is waning; if you lack vim, vigor, vitality; if you are beginning to wear out; if your heart, your liver, your stomach, your kidneys, misbehave—this private prescription of a physician of thirty years standing will strengthen the ailing nerves—strengthen them harmlessly, quickly, surely, till your trouble disappears.

Inside Nerves!

Only one out of every 98 has perfect health. Of the 97 sick ones, some are bed-ridden, some are half sick, and some are only dull and listless. But most of the sickness comes from a common cause. The nerves are weak. Not the nerves you ordinarily think about—not the nerves that govern your movements and your thoughts. But the nerves that, unguided and unknown, night and day, keep your heart in motion—control your digestive apparatus—regulate your liver—operate your kidneys. These are the nerves that wear out and break down.

It does no good to treat the ailing organ—the irregular heart—the disordered liver—the rebellious stomach—the deranged kidneys. They are not to blame. But go back to the nerves that control them. There you will find the seat of the trouble.

There is nothing new about this—nothing any physician would dispute. But it remained for Dr. Shoop to apply this knowledge—to put it to practical use. Dr. Shoop's Restorative is the result of a quarter century of endeavor along this very line. It does not dose the organ or deaden the pain—but it does go at once to the nerve—the inside nerve—the power nerve—and builds it up, and strengthens it, and makes it well.

Don't you see that THIS is NEW in medicine? That this is NOT the mere patchwork of a stimulant—the mere soothing of a narcotic? Don't you see that it goes right to the root of the trouble and eradicates the cause?

But I do not ask you to take a single statement of mine—I do not ask you to believe a word I say until you have tried my medicine in your own home at my expense absolutely. Could I offer you a full dollar's worth free if there were any misrepresentation? Could I let you go to your druggist—whom you know—and pick out any bottle he has on his shelves if my medicine were not UNIFORMLY helpful? Would I do this if I were not straightforward in my every claim? Could LAFFORD to do it if I were not reasonably SURE that my medicine will help you?

Simply Write Me.

But you must write ME for the free dollar bottle order. All druggists do not grant the test. I will then direct you to one that does. He will pass it down to you from his stock as freely as though your dollar laid before him. Write for the order to-day. The offer may not remain open. I will send you the book you ask for beside. It is free. It will help you to understand your case. What more can I do to convince you of my interest—of my sincerity?

Simply state which book you want and address Dr. Shoop. Box 2353 Racine, Wis.

Book 1 on Dyspepsia
Book 2 on the Heart
Book 3 on the Kidneys
Book 4 for Women
Book 5 for Men
Book 6 on Rheumatism.

Mild cases, not chronic, are often cured with one or two bottles. For sale at forty thousand drug stores.

THE IDEAL SIGHT RESTORER

WE RESTORE SIGHT!

GLASSES RENDER DEFECTIVE VISION CHRONIC.

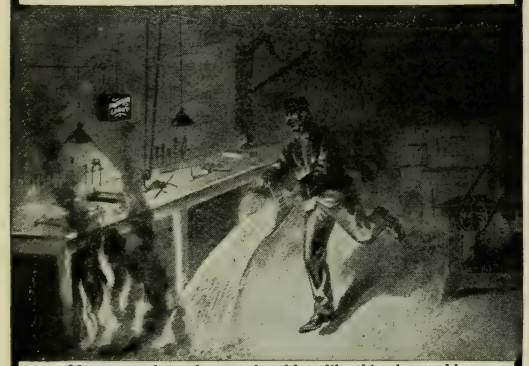
Write for our ILLUSTRATED TREATISE, Mailed Free.

THE IDEAL COMPANY, 239 BROADWAY, NEW YORK.

SAVE MONEY! GET SECURITY! HOW?

By Installing A

Holtzer Watchman's Clock



Many a watchman has caught a blaze like this when on his rounds ringing in on a **Holtzer Watchman's Clock.**

It Reduces Your Insurance Rate | ***It May Save Your Factory***

Do not wait until the fire catches you but write us **to-day.** Let us tell you all about it. **Ask for bulletin No. 1152.**

Holtzer-Cabot Electric Company

New York **395 Dearborn St., Chicago** **Brookline, Mass.**

BIG BRASS BAND OFFER.

We sell the celebrated IMPERIAL, DUPONT and MARCEAU Band Instruments at about one-half the prices others ask for the same high grade goods. For our **Free Band Instrument Catalogue,** also our **Free Booklet,** entitled, "How to Buy Band Instruments," for large illustrations and complete descriptions of our three large lines of brass instruments, also everything in Drums, Clarionets, Flutes, Saxophones, etc., etc., for the free catalogues, our guarantee and refund proposition, for the most liberal band instrument offer ever heard of, for the new method of selling instruments fully explained, for something new and immensely interesting to every bandman, cut this ad out and mail to us today. **SEARS, ROEBUCK & CO., CHICAGO.**

WANTED

10 men in each state to travel, tack signs and distribute samples and circulars of our goods. Salary $60.00 per month, $3.00 per day for expenses.

KUHLMAN CO., Dept. C, Atlas Block, CHICAGO

A. D. 2000.

Give me a spoon of oleo, ma,
And the sodium alkali,
For I'm going to make a pie, mamma;
I'm going to make a pie.
For John will be hungry and tired, ma,
And his tissues will decompose;
So give me a gramme of phosphate,
And the carbon and cellulose.
Now give me a chunk of caseine, ma,
To shorten the thermic fat,
And give me the oxygen bottle, ma,
And look at the thermostat.
And if the electric oven is cold,
Just turn it on half an ohm,
For I want to have the supper ready
As soon as John comes home.

ENGLISH SAFETY SYSTEM OF TRAIN DISPATCHING.

In England the movement of trains is controlled by what is known as the tablet system. These tablets are made of aluminum, or on the South African railways of fiber, and weigh about two ounces each. Each division has its own set of tablets, which will not fit the machines of any other division. The tablets can be exchanged while the train is going 60 miles an hour.

The essential point in the new system is that no engine driver is allowed to leave a station without a tablet in his possession, and the element of safety rests on the fact that the machines are so made that it is impossible for two of the tablets to be out at the same time. If a driver leaves A for B with a tablet, that tablet has to be deposited in the machine at B before another tablet is issued allowing a return train to leave that station for A, and the electrical connection between the two stations makes it impossible to extract a tablet from the A machine until the tablet has been put into the machine at B. It is claimed by railroad experts that under the new system two trains cannot be on the same section at once, so that the danger of collisions is entirely done away with, and that no serious accident has occurred on any English road so equipped during the past 30 years.

RAPID TRANSIT IN SPAIN.

Trains in Spain are among the slowest in the world. A rate of ten or twelve miles an hour is considered a good average of speed for everyday travelers. When the Spanish officials wish to show visiting foreigners what they really can accomplish in the way of speed, they offer express trains which dash madly across the country at an average rate of about eighteen miles per hour.

HOW TO PREVENT ARTIFICIAL LIGHT DEVELOPING PAPER FROM CURLING.

Lay out blotters. On these place muslin from which starch has been washed out, and keep the muslin for just this purpose, says a writer in the American Amateur Photographer. Take prints from the wash water and lay face down on the muslin. When prints are just dry enough so that films will not adhere, and yet while quite damp, they are rolled, film out, around a roller 1½ to 2 inches in diameter. (I use a piece of background roller, the sort they are shipped around), then a small rubber band is placed around each end and the roller removed, leaving a circular form of the rolled prints. All are prepared in this manner (it takes less time to do than to tell), and they are allowed to become stone dry while in this shape, thus allowing the pores of the gelatine film to stretch. The rubber bands are then removed, and if necessary three or four prints at a time are rolled the other way around the roller to make them lie flat. Having been stretched while drying they will not curl again. I find it advisable, when heavy paper with smooth surface is used, to, before placing on the roller, curl the ends of the print backward with a ruler, to prevent the sharp edge marking across the face of the print during the drying process.

NEW BOOKS.

LAIRD & LEE'S DIARY AND TIME-SAVER FOR 1905. Red morocco, vest pocket size. Laird & Lee, Chicago. Price, 25 cents. The sixth annual edition of this valuable little book contains many items of timely interest which its owner will have occasion to refer to during the year. There is also a page for full identification description besides the memoranda pages for every day in the year, and a calendar, cash account and 13 maps.

HOW TO WRITE SIGNS, TICKETS AND POSTERS. Edited by P. N. Hasluck, 160 pages; 170 engravings and diagrams. Cassell & Co., Ltd., New York. Price, 50 cents. Treats of the formation of letters, stops and numerals; the signwriter's outfit; making signboards and laying ground colors; the simpler forms of lettering; shaded and fancy lettering; painting a signboard; ticket-writing; poster painting and lettering with gold. Each phase of the subject is handled skilfully and in a manner calculated to give the reader the greatest amount of information in the least time expended.

MOUNTING AND FRAMING PICTURES. Edited by Paul N. Hasluck. 160 pages; 240 engravings. Cassell & Co., Ltd., New York. Price 50 cents. Treats of making picture frames; art frames; gilding picture frames; picture frame cramps; making Oxford frames; mounting pictures; making photograph frames, covering frames with plush and cork and hanging and packing pictures. Tells how to do the work and it is safe to say that after studying the book the average person could go ahead and make the articles it describes.

A tramp recently rode from Mena, Ark., to Kansas City, a distance of 380 miles, in a trunk. When he left his cramped quarters he was as hungry and thirsty as a hobo ever gets.

Compressed air is reported to have made possible a visit to a dangerous valley in the mountains of Mindanao, in the Philippines. The valley is filled with a poisonous vapor which arises from the crater of an old volcano. There are rich deposits of gold there which have been out of reach. A party of Americans is reported to have taken tanks of compressed air along for breathing purposes and secured a large quantity of gold-bearing sand.

Hydrozone

Cures

Sore Throat

A Harmless Antiseptic.

Endorsed by the medical profession. Send ten cents to pay postage on **free trial bottle.** Sold by Leading Druggists. Not genuine unless label bears my signature:

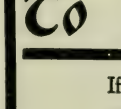
Prof. Charles Marchand

L-63 Prince St., N. Y.

Write for free booklet on Rational Treatment of Disease.

A light when you want it. No chemicals, oil, smoke or odor. Indorsed by Army and Navy, and all Detective Dep't's. Send us **$1.00** and we will ship flashlight complete immediately prepaid. Other Specials: Electric Motors, **$1.50** and 15c postage. Electric Top, 75c and 15c postage. Shocking Machine, **$1.00** and 20c postage. Write for our book No. 6 of Electrical Goods. IT'S FREE. J. ANDRAE & SONS CO., 493 W. Water St., Milwaukee, Wis.

Magic Trick Cards.



With these cards you can perform some of the most wonderful illusions. You can change eights to duces, blacks to reds, etc., The transformations are truly wonderful. **Price, 10 cents** with instructions, and our Big Bargain Catalogue.

Address
Western Specialty Co., 532 E. Minnehaha St., St. Paul, Minn.

To Manufacturers

If you wish to introduce your products into the Republic of Mexico through a progressive, up-to-date, reliable agency, address us.

Ekins & MacQuiston,
Mftrs. Agents
Apartado 74, Mexico City, Mexico

RHEUMATISM

CURED WITHOUT MEDICINE

New Remedy Discovered Which Absorbs Acid Impurities Through the Large Foot Pores.

A DOLLAR PAIR FREE

On Approval--Write To-day.

Don't take medicine for Rheumatism, but send your name to the makers of Magic Foot Drafts, the great Michigan discovery which is curing every kind of Rheumatism without medicine—chronic or acute —Muscular, Sciatic, Lumbago, Gout, etc., no matter in what part of the body. You'll get the Drafts by return mail. If you are satisfied with the relief they give, send us one dollar. If not, send nothing. **YOU DECIDE.**

Magic Foot Drafts possess the remarkable quality of absorbing from the blood the impurities which cause Rheumatism, curing where everything else has failed. They are even curing cases of 30 and 40 years' standing. They will cure **YOU.** Send your name today to Magic Foot Draft Co., 1151 Oliver Bldg., Jackson, Mich. Our splendid new book on Rheumatism comes free with the Drafts. Send no money—only your name. Write today.

CARPETS ON TRIAL

Cut this ad. out and send to us, or on a postal card say, "Send me your Free Carpet Catalogue," and you will receive free by return mail, postpaid, full particulars how we furnish anyone, free, a big variety of large samples of Ingrain, Brussels and Velvet Carpets, you will get our Big Book of Carpets, beautifully illustrated and fully described, over 100 beautiful color plate samples of carpets reduced from 1½-yard lengths, **THE BIG FREE BOOK shows an almost endless variety of Carpets, Art Squares, Rugs, Matting, Oilcloth, Linoleum, Shades, Curtains, Draperies, Upholstery, etc.** Yard width carpet, 11c per yard and upwards; big rugs with fancy border and fringe to cover big parlors, **$1.92** and up. **We will explain why we can sell CARPETS AT ABOUT ONE-HALF THE PRICE OTHERS CHARGE.**

OUR FREE TRIAL PLAN will be fully explained. How we cut and make carpet in any shape to fit any room, our binding quality guarantee, our pay after received terms, quick delivery, color scheme, very little freight charges, all will be explained to you. Cut this ad out and send to us or on a postal card say, "Send me your Free Carpet Catalogue," and you will get all this free, and you will get our very latest and most astonishingly liberal carpet offer, a carpet proposition never known of before. **WRITE TODAY and see what you get FREE by return mail, postpaid.** Address,

SEARS, ROEBUCK & CO., Chicago.

PEANUTS and POP CORN

A BUSINESS THAT PAYS

Machines are earning from $35 to $60 per week. Catalog Free.

S. DUNBAR & CO.

18 & 20 No. Desplaines St.
CHICAGO

CLOCK WITH LOUD TICK FOR AFRICANS.

A Birmingham clockmaker discovered that a rival was sending out large stocks of cheap clocks to the heart of Africa, and doing good business with them. He spent a large sum in making better clocks and shipped thousands of them to the same market. Strange to say, his sales were small; although his rival, turning out a cheap and inaccurate timepiece, was selling all he could make. Finally, he found a key to the mystery. Savages like noise. The clocks made by the first exporter had a particularly loud and aggressive tick. His competitor had made a better clock, but it was almost noiseless, and the savages would have none of it. The next cargo of clocks which the Birmingham maker shipped to the Guinea coast ticked louder than anything ever heard there, and they sold like pink lemonade at a circus. —London Daily Mail.

A SAD STORY.

Wrigley Johnson, who was caught sleeping in a box car in the B. & O. S. W. yards early yesterday morning, evaded punishment in the police court by relating a few of his experiences on the road.

"Judge, Oiv's nuttin' ter deny. Oi stand pat. Oim a hobo pure an' werry simple. Oiv'e hiked it from New York ter Frisco on the cinder paths en' de back roads. Oiv's gnawed ice from de glaziers of Winnipeg, sucked oranges in Floridar, an' rassled wit' chile con carne in Mexico, where de salve comes from. Oi have lost me chum. His name was 'Pinhead' Morrissey. He was well noimed.

"He was a dear old pal an' he prevented a big wreck on the Santa Fe by a little headwork. We was stowed away in an empty in der middle of a long freight which was clawin' its way over der Rockies. On de summit de train broke in two. We was in the foist section. De runaway bunch ob cars come tearin' down de mountain in a sheet of fire and a cloud of smoke. De engineer trun her wide open and our section went humpin' purty lively down der poike.

"Well, he gauged de distance pretty well, an' when the runaways caught up wid us der was not much of a kerlision. Homsomever dey were liable to break away again. It was necessary to couple 'em up again. Me and 'Pinhead' got up on de roof of our car. Dere was no couplin' pin. De link of de foist car in de wild bunch in some way was shoved nicely into de coupler. All was needed was a link. We frisked ourselves ter see if we had one in our pockets, but dere was none.

"A happy thought struck 'Pinhead.' 'Watch me!' he yelled. He ran to de end ob de last car in our bunch, threw his hands up and dove. Would you believe it, he hit de hole in the drawbar fair and square. His nut slipped inter de hole and passed tro' de link. His body was rigid and by stiffenin' his neck a little he kept dat train together until we got to a water tank, where we were heroes for fair."

Police court attaches were stunned. All were silent for a time and then Acting Judge Schwab said: "Dismissed; that was a bird."—Cincinnati Enquirer.

PICK COTTON TO RAISE CHURCH MONEY.

The cotton is white for the harvest, but, verily, the pickers are few. At Terrell, Texas, a Sunday School class are earning their donation to the church fund by picking cotton at 75 cents per hundred pounds. The class earned $5.30 the first day. In the vicinity of Augusta, Ga., picking is being carried on by moonlight, those working from sundown to midnight receiving a bonus.

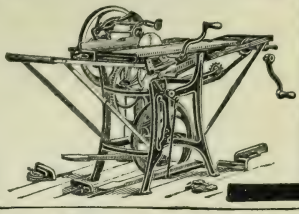
FOOT AND HAND POWER

Wood Working Machinery

For Carpenters, Cabinet Makers, Wagon Builders and Wood Workers Generally.

Machines for Scroll Sawing, Ripping, Cutting Off, Mitering, Rabbeting, Grooving, Gaining, Dadoing, Beading, Edging Up, Boring, Mortising Tennoning, Turning, Etc., for Working Wood in any manner

ENTERPRISING MECHANICS ARE QUICK TO SEE THE SUPERIOR MERIT OF OUR MACHINES ::::



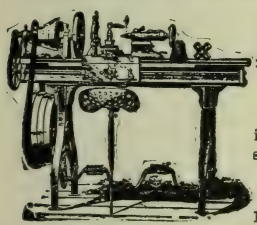
Machines Sent on Trial. *Send for Catalogue "A."*

The Seneca Falls Mfg. Co. 102 Water St. Seneca Falls, N. Y.

CONVERT DOGFISH INTO GLUE AND FERTILIZER.

In order to rid Canadian waters of the dogfish pest, the minister of marine and fisheries has decided to establish three reduction plants to convert the fish into fertilizer and glue, says United States Consul-General Holloway at Halifax. It was first intended to offer a bounty on the pest, but afterwards decided that this method would not completely exterminate it.

Each of the reduction plants will cost $9,000 and will be operated by the government. Fishermen will be paid a good price for the fish offal and dogfish they bring in and the minister believes the enterprise will yield a fair profit.



LATHES

9 to 13 inch Swing

List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices

W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

FOOT and POWER

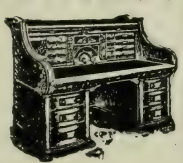
AND TURRET LATHES, PLANERS SHAPERS AND DRILL PRESSES ::::

SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio

IT HELPS BUSINESS

To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs



Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

The A. H. Andrews Co.
174 Wabash Ave., • • Chicago

STYLISH SUITS

MADE TO ORDER $10

Do you want an up-to-date **All-Wool Suit or Overcoat,** made to **your measure** that will fit you perfectly, from the newest most fashionable fabrics?

Do you want to be **absolutely satisfied** with style, fit, quality and value we give before you pay for them? We will give you a pair of **All-Wool Tailor-Made**

$5 Trousers Free

with your first suit order providing you will hand our Samples, Style Book and Offer to 10 of your friends whom you believe will buy clothing this season.

We know we can **fit** you and **save you money.** In order to prove it to you, we will make you a **suit or overcoat to your order,** from your choice of any of our $10, $12.50, $15 or $18 samples, and send it to you together with the **$5 free Trousers,** and give you 5 days to decide whether you wish to keep the garments. **Isn't that a fair offer?**

Write to-day for our full line of Suit Samples in Clay Worsteds, Thibets, Serges, Tweeds and Cassimeres, in all colors, including the **new brown;** also Overcoat Samples in Irish Frieze and Kersey, and our New Style Book, showing life-like half tones of the latest style **Suits, Overcoats and Trousers. ALL SENT FREE,** together with order blank, instructions for taking measurements, etc. We will also send you a list of the persons in **your own town** for whom we have made suits. **Write today** for samples and our **Free Trousers Offer.**

OWENT. MOSES & CO., 212 MOSES BLDG, CHICAGO

References: Any one of our 900,000 Customers or The Milwaukee Avenue State Bank, Chicago. Capital Stock, $250,000.00.

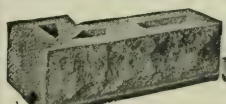
SEE SPECIAL OFFER

ELSEWHERE OF OUR NEW BOOK

"Popular Mechanics Shop Notes"

JUST OUT

THE WINGET **CONCRETE BUILDING BLOCK MACHINE**



Automatic Adjustable

Makes any size or shape block required in ordinary building operations

Straight & Corner Block

A. D. MACKAY & CO., Chamber of Commerce, CHICAGO, ILL.

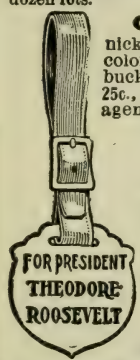
Show Your Colors

PATENT APPLIED FOR

BOY OR MAN

Encourage your party by showing which "side of the fence" you are on.

Our Campaign Novelties are unique, attractive and artistic. **Roosevelt and Fairbanks Eyeglass Pins** [see cut above] gold plated. **Sample Price 25c.**, postpaid. Special price on dozen lots.



Campaign Fob. Handsomely nickeled — lettering enameled in three colors, russet leather strap and nickeled buckle; for both candidates. **Sample price 25c.**, postpaid. Special quantity prices to agents at $1.80 per dozen.

Both These are Great Sellers.

These will make good souvenirs of the campaign and will be useful after the vote is taken.

We also make special designs of fobs or pins for clubs, colleges, schools, institutions, etc., and will quote you low rates for the asking. Write for samples today.

CHICAGO COMMERCIAL AND SPECIALTY CO.

534 W. 63rd ST., CHICAGO, ILLINOIS

$1 BUYS THE GENUINE SALADIN RAZOR

THE BEST RAZOR MADE AT ANY PRICE.

Hand forged from the finest razor steel in the world. Made and tempered by experts, ground by hand, ⅝ inch blade with double shoulder, set ready for use. Fully warranted. We guarantee satisfaction. If the razor we send you is not right EVERY WAY, we replace it until you are completely satisfied. A trial will convince you. Don't pay $3 to $5 for a razor no better or not as good.

Postpaid on receipt of $1.00. Address

HOME MERCANTILE CO., Dept. 24, Crossdale, Ill.

Amended.—"Mother thinks you'll make me a good wife," said the girl's intended. "Indeed?" replied the girl with the determined jaw. "You tell your mother I'll make you a good husband."—Philadelphia Ledger.

HOW TO SHAVE YOURSELF AND KEEP YOUR RAZOR IN GOOD CONDITION.

Honing, Stropping and Other Mysteries of the Tonsorial Art Explained for the Amateur.

By Hirst Clem Stewart.

Although men have been shaving since an instrument that would cut their whiskers was invented, comparatively few, even yet, know how to shave themselves. The razor was alluded to by Homer and in ancient times shaving was in fashionable use by the Greeks and Romans as a mark of distinction. Savage nations, the Tahitians, for instance, used pieces of shell and shark's teeth upon which they ground very fine edges sufficiently sharp to remove the beard. Such razors are yet in use among some of the uncivilized tribes. Shaving was introduced among the Romans about 300 B. C. Pliny says Scipio Africanus was the first Roman to shave every day.

From earliest times the wearing of beards has been a matter of fashion, an extreme in one way usually being followed by an extreme in the other. Just now smooth faces, or merely moustaches, are in vogue and hence it behooves all men to learn to shave themselves.

If you are able to have your own private barber who shaves no other but you, it is probably more satisfactory than shaving yourself. Otherwise it is not. Many who would scorn to wash their faces in the water used by another person, do not hesitate to have their faces lathered by the brush that has gone over a hundred faces before; their skin rubbed by the barber's hand that has rubbed the skin of twenty other faces the same day, and their whiskers shaved by a razor that has shaved scores of men previously. The barber may wash his hands well, may carefully cleanse his brush, but he usually dips his brush into the same mug of soap and on some faces there are germs that adhere to the barber's hands and which washing the hands will not obliterate. Many serious skin diseases have thus been contracted. But aside from the danger, it is unclean.

Therefore shave yourself. Buy a good razor, strop and brush. The price of each is usually the best index of the quality, though opposing opinions are many. It is better to have two or three razors, for a razor is a delicate piece of steel and requires an occasional rest. This is the most peculiar characteristic of the razor and one that cannot satisfactorily be explained. But you can easily observe it yourself. If you have two razors and one gets so that it will scarcely cut your whiskers, just lay it aside for two or three weeks. Then try to use it again and the chances are that it will shave most satisfactorily.

How to Strop a Razor.

Stropping the razor is the first thing to learn when you begin shaving yourself. In this the first

Send 10c extra for postage, etc.

FREE ***This Fine Hollow Ground Hand Finished Razor Will for a Limited Time, be Given Free to Every Purchaser of the***

Radiumite Dollar Razor Strop

We make this remarkable free offer of a most excellent razor, that sells at **$2.00** at retail, to acquaint all with the marvelous and instantaneous honing and finishing properties of the **RADIUMITE STROPS** which will not harm the finest and most delicate razor. They make shaving a convenience and a delight, even to men having the hardest beards.

The secret of a quick, clean shave does not lie so much in a good razor as in a good strop. With the **RADIUMITE STROPS**, the most inferior razors are brought up to a fine edge, and the effect of the strops upon the finest razors is to keep them at all times in the best possible condition, ready to shave the hardest beards easily and delightfully. **Each Radiumite Strop is sold under the positive guarantee that if it is not satisfactory your dollar will be refunded.** They are for either Ordinary or Safety Razors. Most dealers handle the **RADIUMITE** products. **Those who do not are rapidly taking them on.**

Radiumite Strops--50c to $2.50. Radiumite Razors--$1.00 to $3.00. Radiumite Catalog free to all.

THE STROP THAT HONES

When you buy, buy right—say Radiumite to your dealer.

We want good agents for introductory purposes—men with a large acquaintance among the business, office and factory men of their respective towns.

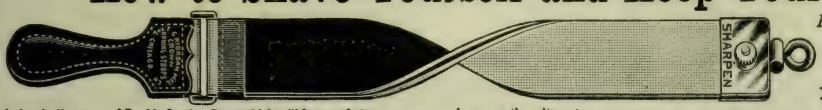
THE PETER L. FROST COMPANY

Dept.15, 95-97-99-101 S. Clinton St., Chicago, U. S. A.

DEALERS, WRITE FOR TRADE DISCOUNTS!

CATALOGUE FREE.

"How to Shave Yourself and Keep Your Razor"



First: USE A CROWN HONING STROP

See Editorial in this Magazine for November.

A chemically prepared Double Leather Strop which will hone and strop any razor saving many times its cost. For private use this strop will last a life time. If your dealer does not handle it send us his name and We will mail you one in a neat box. $1.25

The T. G. RIORDAN MFG. CO., Chicago, Ill.

rule is to not over-do it. Many people strop the life out of a razor. Why, I had a man tell me the other day that he stropped his razor for five minutes and then it would not cut, which, he said, proved that the razor was no good True, it was no good now, but it was because he had stropped it too much. In over-stropping you get a round edge on the razor and it goes over the face like the runner of a sleigh over the snow. What you want is a sharp, keen-cutting edge, and if you strop your razor four or five times lightly, it will shave with comfort, provided it has not already become dulled from too much stropping. In stropping be sure and do not press the razor hard against the strop. Do not lift the blade off the strop; merely turn it over on its back each time, with the back always against the strop, as a pivot. By this means you secure one long bevel instead of a dozen little bevels. Remember that a razor's edge under the microscope looks like a fine saw and the finer the teeth the keener the edge. A cheap strop will spoil the best razor made, so always be careful to buy a good strop.

With your razor stropped so that it will shave smoothly you are ready to shave. Make a substantial stiff lather in the mug by using a small amount of moderately warm water. Lather your face well with the brush and then rub the lather well into your face with your fingers. The longer you lather and the more you rub the easier the shaving. Shave the cheeks downward and always guide the razor in the direction the whiskers grow. In planing a board it is a hard job if you plane against the grain, and you often ruin the board. So it is in shaving a hard task shaving against the grain and you are liable to ruin your face, or make it very sore. Use a sliding motion as well as downward in handling the razor, for it thus gives double service to the stroke. In holding the razor, lay it as flat as possible—the back of the razor touching the face. Do not pull the razor straight down the face with one stroke of the hand as if you were cutting grass, but give it a diagonal and swinging motion as if you were sawing the whiskers off.

If you should accidentally cut yourself, wash with cold water and rub the cut with a piece of lump alum. That stops the bleeding at once and helps to heal the cut.

In beginning shaving, start on the right side of the face. Looking in your mirror see that you hold the razor flat against the face, and with the arm reaching over the head draw the skin tight with the left hand. In shaving the right side of the face under the jaw bone, draw the skin with the left hand and continue cutting downward as far as the center of the neck. The skin is tender here, but a little care is all that is needed. Do not press the razor too hard against the face.

Many people will not take the trouble to learn to shave the left side of the face with the left hand, but it is much handier to do so and a little practice and patience will soon overcome the awkwardness you at first experience and show you the many advantages of using the left hand. Draw the skin tight with the right hand held across the nose or with the arm reaching over the head. This same position is retained in shaving the right side of the face and the neck. Some people have great difficulty in shaving under the chin. In this operation I would suggest that you hold the head back and draw the skin tight. To shave the left side of the face under the jaw bone, hold the head back and a

HAVE YOU SEEN IT?

THE LUKINS

GLAESUM HONE

FOR SHARPENING

RAZORS, SURGICAL AND DENTAL INSTRUMENTS.

It is absolutely the ***ONLY*** perfect Hone ever made with which a man can hone his own razor with perfect satisfaction. The surface will always remain true. ***Gives the Razor just the right edge and Gives it Quick*** Use it 30 days, if not entirely satisfied send it back and we will return the money. Sent postpaid for 75 Cents.

F. M. LUKINS COMPANY, 412 Germania Life Bldg. ST. PAUL, MINN.

FREE HAIR GROWER

MISS EMMA EMOND, of St. Sauveur, Quebec, Can., before and after using Foso Treatment

A trial package of a new and wonderful remedy mailed free to convince people it actually grows hair, stops hair falling out, removes dandruff and quickly restores luxuriant growth to shining scalps, eyebrows, and eyelashes. Send your name and address to the Altenheim Medical Dispensary, 2055 Foso Building, Cincinnati, Ohio, for a free trial package, enclosing a two cent stamp to cover postage. Write to-day.

AN INCOME FOR LIFE

I will send you **free,** booklet telling how to make $1 earn $10, larger amounts in proportion. A few of your idle dollars invested will bring an income for life Send no money, booklet is free. Just a few left. Address

J. B. LAWRENCE, 112 Michigan Street, CHICAGO

This ELEGANT Watch $3.75

Before you buy a watch cut this out and send to us with your name and address, and we will send you by express for examination a handsome **WATCH AND CHAIN C. O. D. $3.75.** Double hunting case beautifully engraved, stem wind and stem set, fitted with richly jeweled movement and guaranteed a correct timekeeper; with long Gold plated chain for Ladies or vest chain for Gents. If you consider it equal to any $35.00 GOLD FILLED WATCH Warranted 20 YEARS pay the express agent $3.75 and it is yours. Our 20 year guarantee sent with each watch. Mention if you want Gents' or Ladies' size. Address

H. FARBER & CO., C31, 23 Quincy St., CHICAGO.

What Is Daus' Tip-Top?

TO PROVE that Daus' "Tip Top" is the best and simplest device for making **100 copies** from pen-written and **50 copies** from typewritten original, we will ship complete duplicator, cap size, **without deposit** on **ten (10) days' trial.** *Price $7.50 less trade discount of 33⅓%, or* **$5 net**

THE FELIX S. K. DAUS DUPLICATOR CO.
Daus Building, 111 John St., New York City

"HASTINGS" Compound for Dynamos and Motors
POCKET SIZE, 60 CENTS
Money refunded if it don't do the work. This is the only compound sold with a guarantee.
JAS. L. NEEFUS, Sole Agent, - - 45 Dey St., New York City

CRANE VALVES
ESTABLISHED 1855

BRAZE CAST IRON
With our new compound. BRAZIRON, used with ordinary spelter and borax makes the brazed joint stronger than the solid cast iron. Work can be done in any forge or brazier. A good specialty for bicycle and blacksmith shops.
Every machine shop needs it. Send 60 cents for one box Braziron by mail postpaid. One box contains enough for twenty to fifty or more jobs. Send $1.00 and get our HANDY BRAZING OUTFIT, containing one box Braziron, one box flux and one coil wire spelter, by mail postpaid. Agents wanted to introduce Braziron in shops and factories.
WRITE AT ONCE FOR FULL PARTICULARS
THE A. & J. MANUFACTURING CO., 17 So. Canal St., Chicago. Ill.

little to one side, just enough to draw the skin tight. Observe the same instructions in going over the face the second time, except that instead of using lather moisten the face with warm water, or bay rum or witch hazel. When through, wipe the razor dry and strop it two or three times.

Neither is there any use of going to the barber to have your razor honed. It is an extremely simple process, and for your own use you probably can do the work better than a barber. Selecting a good hone is of primary importance. You can tell whether it is good or bad by looking at it. The hone should be clean and should have no flaws or hard spots in it. See that the grain is neither too coarse, nor too fine. If too coarse it will give to the razor blade a coarse-cutting edge; while if too fine it will be a slow process to hone the razor. So in shaving as in other things avoid extremes. Do not let any oil get on your hone. Use lather made from soap and water, the same lather as you put on your face.

After lathering the hone, lay the razor flat on it, and draw the edge toward you. You may press on the razor during the first four or five strokes, but do not press too hard. After that glide the razor over the hone with its own weight. As you think the razor is getting sharper, draw it slower and slower. Let the last few strokes be extremely gentle, merely letting the razor touch the hone. Delicate handling of a razor is the secret of its success. When you have made the last gentle stroke on the hone, wipe the razor dry and strop it. Use only the finishing side of the strop and bear lightly on the blade. Try the razor after stropping it by cutting a hair, and if it cuts it as soon as it touches the hair the razor is ready for use.

The canvas side of the razor strop is rarely ever of use to the person who shaves himself. Sometimes it may be employed in lieu of a hone when you may think the razor is not dull enough to be honed, but the advisability of this even is doubtful.

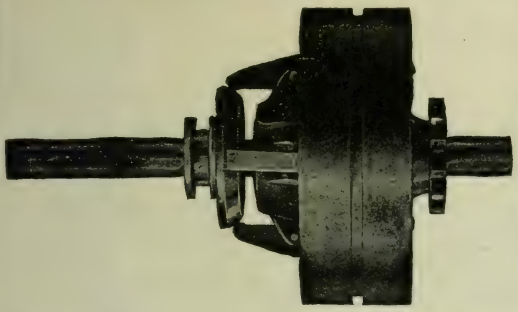
Caring for your hone, strop, brush and razor is of first importance. The razor should be kept in its case perfectly dry when not in use. The razor strop should be rubbed with shaving lather about once every two weeks to keep it soft and pliable. Lather it well with the lather you use in shaving and rub vigorously with the hand until the strop is dry. This operation may be repeated two or three times in succession. The shaving brush should be thoroughly washed after each shave, wiped dry and placed where it will keep clean and dry until needed again. Some lay the brush crosswise the top of the cup, but a better plan is to hang it up with the brush down by means of a little brass holder attached to the wall, similar to the holders used in keeping rubber stamps. Wipe the hone dry when you have finished using it, and also keep it well covered so that it will not accumulate dust. Wipe it with a soft cloth before using to remove any dust.

You should always have two razors, one for the first operation of shaving and one for going over the face the second time. The latter should always be kept extremely sharp and the beauty of it is that it will remain that way for a great length of time with the necessity of very little stropping. The two razors add much greater pleasure to shaving. It is going over the face the second time that usually causes any soreness, and with the sharp razor ever ready for this light work the face is generally kept in a much better condition. It is easier to keep the two razors sharp than to keep one sharp.

"The hardest knife, ill-used, doth lose his edge."—Shakespeare, Sonnet XCV.

THERMO-PILES
1½ Volts 1½ Amperes
For Electrolytic Analysis, Charging Storage Batteries, Driving Small Motors, Etc. No chemicals, no smell. $3.00 EACH.
WALSH'S SONS & CO., 261 Washington St., Newark, N.J.

MANUFACTURERS Why not locate where intelligent labor, raw material and demand for your product obtains. All these and more found on the BURLINGTON ROUTE. For information write to
Burlington Route
W. H. MANSS, Industrial Commissioner
209 Adams Street - - - - - - - - Chicago



Transmissions

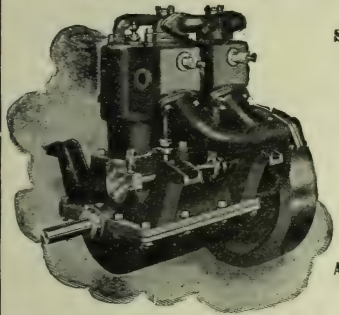
The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

Successors to THE P. J. DASEY CO.

339 Michigan Blvd. Chicago, Ill., U. S. A.

AUTOMOBILE AND MARINE MOTORS



SIMPLE, COMPACT and POWERFUL

Best material.
Perfect workmanship.
Send for Catalog.

ALEXANDER & CROUCH,
71 W. Monroe St.,
Chicago

1, 2 & 4 Cylinder 4, 8 & 16 H. P.

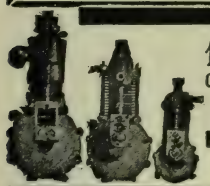
KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog
Int'l Power Vehicle Co., 381 Dearborn St., Chicago

A MOTOR-CYCLE AT SMALL COST

By using one of our Attachable Outfits. THOROUGHLY PRACTICAL. In USE FOUR YEARS. Also a complete line of Motors, Castings and Accessories for Bicycle, Automobile Marine or Stationary.
Send stamp for Catalogue.

STEFFEY MFG. CO.
Brown and Pnenock Sts., Philadelphia, Pa.



1¾ H. P. Bike Motor, $7.50

CASTINGS WITH DRAWINGS, Latest Model
We also have them in 2 1-2 H. P.

For fuller information address
Eureka Mfg. & Supply Company,
St. Paul, Minnesota

IMPORTED IMITATION

DEDION SPARK PLUGS JUST NOW - - - 40 cent each

THE MOTOR CAR SUPPLY CO.
1427 Michigan Ave., Chicago, Ill.

TYPEWRITERS ALL MAKES

All the Standard Machines Sold or Rented Anywhere at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g
Typewriter Emporium, 196 La Salle St., Chicago

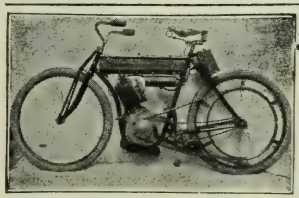
WE CAN KILL THOSE

IGNITION TROUBLES

DURO BATTERIES ARE THE MOST DURABLE, COMPACT and EFFICIENT

The Only Way of Obtaining a Mileage Guarantee

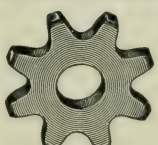
Chicago Battery Co.
1421 Michigan Avenue, Chicago



Motorcycle $125

2 H. P.
1¼ H. P. Engine Castings
$7.00

H. HOFFMAN MOTORCYCLE EXCHANGE
719 Sheffield Ave., Chicago



SPROCKETS

and EQUALIZING GEARS
IN STOCK OR TO ORDER.
Standard makes of Chain on hand.
Prompt delivery.....Catalogue free.

CULLMAN WHEEL CO., 522 Larrabee St., Chicago

Men of business prefer The

California Limited

Santa Fe

The train "wears well"; mainly because the service is faultlessly good every mile and every minute.

Santa Fe All the Way--that's the reason.

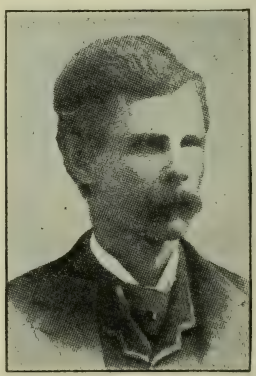
Daily service will be resumed November 13, superseding present semi-weekly schedule, Chicago to Los Angeles and 'Frisco.

For pamphlet of the train, and California trip book, address Gen. Pass. Office, A. T. & S. F. Ry., Chicago

THE STORY OF THE INVENTOR OF THE NAPHTHA LAUNCH.

Frank W. Ofeldt, the inventor of the naphtha launch, was born in Sweden on May 24, 1836. From his youth he was deeply interested in mechanics. At the age of 30 he came to America, the place offering the best advantages for the man who would rise in the world. He had so little knowledge of the English language, however, that he was obliged to accept a position as a laborer in laying out Prospect Park, Brooklyn. His employers discovered he could handle a theodolite and he was advanced. During all this time his knowledge of English was growing.

Later while employed in a machine shop engaged in the manufacture of looms, Mr. Ofeldt invented a machine for the manufacture of illuminating gas generated from gasoline. The invention drew capital and the old Star Gas Machine Works of Newark, N. J., was formed. While still working at and improving this machine in 1882 Mr. Ofeldt discovered the expansive property of naphtha, which he connected with the propulsion of boats, and so devised the naphtha launch. Formerly launches had been little used, because the use of the steam boiler necessitated so much bulk, but with Mr. Ofeldt's invention they became popular the world around. It was patented in 1883 and a stock company called the Gas Engine and Power Company was formed, with the inventor as vice-president. After a year and a half he resigned. In 1888 he invented the Ofeldt naphtha steam system, constructed by a New Jersey firm on rovalty, with Mr. Ofeldt as mechanical engineer. The company failed in a year and Mr. Ofeldt, with his sons, manufactured the engine from 1889 to 1892.



Frank W. Ofeldt

He later invented the Alco-Vapor engine, which he sold to the Marine Vapor Engine Co. in 1895. He then returned to Brooklyn and built the device known as the Compound Vapor Motor, which he declared was the climax of all he had invented, as it was lighter, safer and more reliable than any of the other inventions. His was a great and prolific mind, leaving tangible results to the world. He died in September of the present year at Brooklyn, N. Y.

MAGIC BILL BOOK

FUN

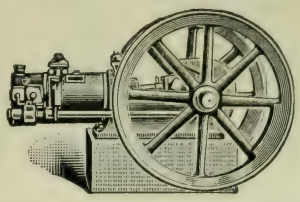
The slickest thing out—Get one and you will have them all guessing. Bills placed in the Magic Bill Book change from one side to the other in a mysterious way. No one can explain it. Substantially made and will last a lifetime. Prices, 10 cents, postpaid, 3 for 25 cents.

W. H. Miller Supply Co.,
727 East 4th St., - - St. Paul, Minn.

The Marked Superiority of the

"OTTO" GAS AND GASOLINE ENGINES

In ease of starting and smoothness of running is readily apparent when compared, side by side with the cheaper kind.



While "comparisons are odious," they are sometimes helpful in arriving at the truth. See our exhibit at the World's Fair, Block No. 41, Machinery Hall, and draw your own conclusions.

The OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn St. MINNEAPOLIS: 318 3d St. OMAHA: 1108 Farnam St.

A FEARFUL FALL.

As we watched an artist, not long ago, skillfully retouching the frescoes in the dome of the capitol at Washington, we recalled a story of another artist whose "retouching" of a dome ceiling came near being his last work. Just starting out to earn his living, he said he was ready to paint anything from a portrait to the sky piece in a theater. He told his story thus:

"One of the public buildings in the capital had a big dome, and on the ceiling of the dome was a great deal of elaborate painting that had become dingy, and needed retouching. I was pleased enough when I got the job of doing it.

"They erected a staging for me to work on—a frail-looking affair, which almost turned me sick when I arrived with my outfit and stood in the rotunda, looking up at the dome, a hundred and fifty feet above me.

" 'I shall be so dizzy I can't hold a brush,' said I to the carpenter.

" 'Oh, that will be all right!' said he. 'We're going to spread a big canvas under the staging, for the rotunda is in use all the time, and you'd be spotting everybody below with paint unless we had something to protect them.'

"I felt relieved when I heard that, and still more relieved when I had climbed up into the dome and found that the entire rotunda below was hidden by a taut cloth which the workmen had stretched across.

"I had been at work nearly two days when I began to get careless in stepping round the staging. I suppose the canvas below me gave me a feeling of comparative safety. About noon one day I took a step backward to look up at some drapery which I had just repainted. My foot touched only the air, and I fell into the canvas.

"There was a ripping and tearing of cloth as I settled down into the hollow. I lay there flat on my back, and looked round with an interest in the quality and strength of the canvas and the way in which it was fastened that you may be sure was sincere.

"There was no doubt about the strength of the fastenings; they were of rope, tied round big knots in the cloth, and strong enough to hold a horse. But the canvas itself was frightfully thin, and was mildewed in spots. I turned over on my face and found myself staring through a rip down to the marble flooring of the rotunda, a hundred feet below.

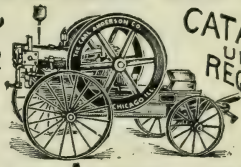
"I was comfortable enough physically, but mentally! Every time I moved something would stretch and tear.

"Of course I yelled for help, and after a time I heard answering shouts down below. The canvas was sagging down in the middle and straining and squeaking along the edges. I figured out that it would take the workmen at least two minutes to

ASK FOR CATALOG F.

THE "GUS" GAS AND GASOLINE ENGINES

NONE BETTER MADE



CATALOG UPON REQUEST

THE CARL ANDERSON CO.

23-27 N. CLINTON ST. CHICAGO

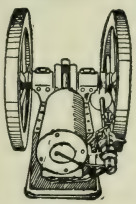
WE BUILD GASOLINE ENGINES

Automobile, Marine and Stationary

Transmission, Gears, Carburetters, Pumps, Mufflers, &c.

Write for circular and prices before ordering

W. B. MURRAY, 1253 Milwaukee Avenue, Chicago



Gasoline Engines

"HONESTY IS THE BEST POLICY"

THIS IS OUR POLICY

LET US PROVE IT TO YOU

Send for Catalogue. Engines 1 to 500 H. P.

CAVANAUGH & DARLEY

25 West Randolph Street, Chicago

NOTHING BUT THE BEST

EVER GETS INTO OUR

GASOLINE ENGINES

All small wearing parts are of hardened tool steel. On every piece the work is better than seems necessary, but it pays, and we are sure that our customers will appreciate it in years to come.

Catalogue of our 2¾ H. P. dust proof type for the asking.

McNAUGHTON - BASSETT CO.

CHARLOTTE, MICH.

WHAT IS BEST FOR CHRISTMAS

We make the choice easy. Write for our big list *to-day*. Don't puzzle about Christmas gifts—select from our useful, practical, pleasing "MAGIC" Electrical Novelties:

For "HER"—artistic clock, lamp; candle stick, etc.
For 'HIM"—cane, cigar-lighter, scarf-pin, pocket light, etc.
BOYS like telephone or telegraph outfits, motors, bells, etc.
LITTLE ONES like locomotives, trolleys, tops, etc.

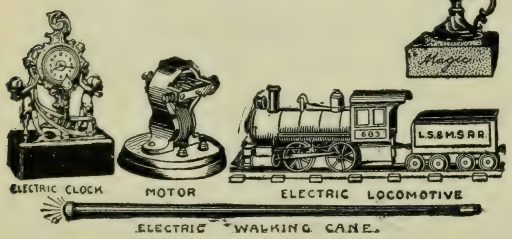
Our white and ruby lights will beautify the Christmas tree.

Our "MAGIC" ELECTRIC SEARCH-LIGHT is fine wherever fire is feared—attics, cellars, barns, outhouses. Useful anywhere, to anyone. Fitted with dry-battery—no wires—no chemicals—no smell. Absolutely SAFE and RELIABLE.

"MAGIC" Goods Guaranteed to Satisfy or your money back. Postal today brings big catalogue of Electrical Novelties and Supplies—lots of pictures.

AGENTS—Write for our attractive proposition.

J. W. SCRIBNER & CO.,
205 Niagara St., Tonawanda, N.Y.



BIG PAYING BUSINESS
FOR MEN AND WOMEN.

Write for names of hundreds of delighted customers. Make $60 to $50 weekly. Do business at home or traveling, all or spare time, selling Gray outfits and doing genuine gold, silver, nickle and metal plating on Watches, Jewelry, Tableware, Bicycles, all metal goods. Heavy plate. **No experience,** quickly learned. Enormous demand. **No toys or humbug.** Outfits all sizes. **Everything guaranteed. Let us start you. We teach you FREE.** Write today. Address,

H. GRAY & CO., Cincinnati, Ohio.

CO-OPERATION

is the mystic key to fortune, fame and happiness. We hold the **key**, but cannot turn it alone. We will share with **you** in the greatest **money-making** co-operative business on earth. We are **giving away 250,000 shares** of Treasury stock. Par value $1.00 per share. Not a share can be bought for cash.

There's 20 Shares for You

No more for anyone. **We don't want your money,** don't send us a cent, just a postal card. Our plan is **unlike** that of the trusts who give millions of shares to drones, called "promoters." We are giving ours to **partners**—energetic men and women. This stock will pay large dividends and costs you—just a **little effort—that is all**—fortune's knock is at your door, believe it or not, as you please.

THE PEOPLE'S COMPANY
144 West Madison Street, Chicago

"YOUR LAST CHANCE"

To get our electric motors for 65c. postpaid. Our offer will expire with this ad. Induction Coils, Novelties, Supplies, Etc. Catalogue free. Address all correspondence to our new location.

Artesian Electric Co., 744 Artesian Ave. CHICAGO

Pure Water

is a necessity; but, unfortunately, is scarce.

Why drink microbes in unpurified water? You need not--get a TEAKETTLE WATER STILL. Supplies water that's not only clear but absolutely sterile or free from dangerous germs. You don't have long to wait for it, either--gallon an hour--costs but little. Save your health. Send for Booklet.

Teakettle Water Still Co.,
117 W. Federal St., Youngstown, O.

climb into the dome. By the time they got to me I thought I should be spread out below.

"I tried to move up the incline of cloth, scrambling along on my stomach and pushing with my feet; but the attempt widened the rip in the canvas. Suddenly, as I pushed harder with my feet, one foot and nearly the whole leg shot through the canvas.

"I could hear the scream of women below. My finger-nails scratched and clawed the rough surface, but of course made little impression. They simply kept me from slipping quite so fast. Then I heard the steps of men on the scaffolding. They let down a rope that curled near my fingers, but it was several seconds before I dared to let go my hold on the canvas for a sufficient time to grasp it.

"Finally I got both hands on it, and they dragged me up the incline to the staging."

REGULATING GASOLINE ENGINE.

The object in mixing air with gasoline vapor is to obtain enough oxygen to cause complete combustion to take place. All oils may be ignited and burned at the proper temperature, if a sufficiently high temperature is produced so that air can circulate and mix with vapor, says the Automobile Review. At certain temperatures such oils give off inflammable vapors, and at a higher point may be ignited themselves. The first temperature is called the flash point, the second the fire point. If the air supply is cut off, neither the vapor nor the liquid can be ignited. Again, if too much air is present, the mixture cannot be exploded.

In a gas engine cylinder it is necessary to know how much air must be admitted. The most efficient proportion of air and gas, mixed to give good combustion, using average gasoline, is from 6 to 1 to 10 to 1, according to the weather and engine conditions. The vapor is the chief agent of efficiency, the conditions necessary to explosion being furnished by the air. Increasing the proportion of air up to the specified limit increases the total efficiency.

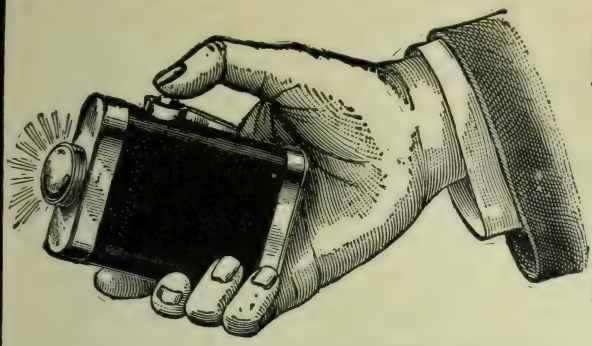
BIG BEE BITES BITER.

A Pennsylvania man bit into a peach the other day and was stung by a bee which was having a good time in the interior of the fruit. If people will butt into the business of others, they must not complain of the consequences.

A $50 Watch for $3.60
Chain and Charm FREE.
GUARANTEED FOR 30 YEARS

This is a Genuine Gold-Filled Engraved Watch in appearance, double hunting-case, stem-wind & stem-set, and fitted with a high-grade ruby jeweled movement. Send us this ad. and we will send the WATCH, WATCH CHAIN AND CHARM C.O.D. $3.60 and express charges. Make careful examination then pay express agt. $3.60 and express charges and it's yours. Write if you desire Ladies' or Gents' size.

GUARANTEE WATCH CO., Dept. 216, Chicago.



THE RELIABLE

ELECTRIC VEST POCKET LIGHT

If you wish to find a house number at night; if you wish to find an article you have dropped; if you wish to avoid dangerous places in dark streets, just "press the button" and you have an instant, brilliant light. Will give eight thousand flashes, or burn three months with right usage. Inexpensive to buy and to operate!! Invaluable to physicians, or miners and gasfitters who go in dark places where any other form of light is dangerous. Batteries and bulbs easily detached and renewed when required.

$1.00—Complete—$1.00 Postage 10c extra. Extra batteries 30c. Extra bulbs 35c. Agents Wanted Write for prices in quantities and complete catalog.

HOWARD ELECTRICAL NOVELTY COMPANY

183 Lake Street, Chicago

RECOGNIZED THE WOLF.

It is told of an eccentric and eloquent Scottish divine that he once met a couple of his parishioners at the house of a lawyer notorious for his sharp practice, and of whose honesty the minister had no great opinion.

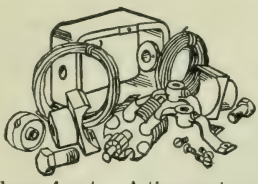
Said the lawyer, jocularly but ungraciously, "Doctor, these are members of your flock. May I ask, do you look upon them as white sheep or black sheep?"

"I don't know," replied the reverend doctor, drily, "whether they are black or white sheep, but I do know that if they are long here they are pretty sure of being fleeced."

PAPER FIRST MADE BY CHINESE.

It is said to be a positive fact that the Chinese made a paper from a fibrous bark 1,800 years since and, as the civilization of the Celestial empire at a remote date was of a superior character, it is probable that we owe our present paper of commerce to that mysterious people.

The Spaniards in 1151, A. D., made pulp from woolen and cotton rags and manufactured paper from this material. Flax and hemp became prime products in the industry and then linen rags gained first place in popular favor. The manufacture of paper attained its first degree in Spain and then spread into Italy, France and Burgundy; later into Germany and the Netherlands, reaching England in 1588, the first fine white paper being made there in 1690. The art saw its inception in America in 1690, a factory being established near Philadelphia by William Rittenhouse.



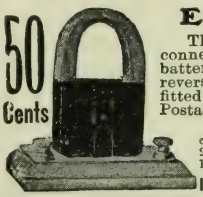
YOUNG MEN why don't you build your dynamo motor or water power plant? Our finished parts are modern, up-to-date and complete. No tools or machine shop needed to make a successful machine. They furnish an opportunity to wind a dynamo and try your own work at a less expense than any other known method. Indorsed by all electrical students. Sizes 25-50-75 watt 1-4 and 1-2 h. p. Catalogue, 4 cents. Active agents wanted.

C. S. Piper & Co., 4352 Cottage Grove Ave., Chicago.

POPULAR MECHANICS

Cen give you the address of the maker of any

MACHINE OR TOOL



ELECTRIC MOTOR

The Rienco Motor runs at high speed when connected to one cell of almost any kind of battery. It rotates in either direction and is reversed without changing connections. It is fitted with grooved pulley. Price, 50 cents. Postage and packing, 15 cents.

Motor Outfit No. 8

consists of 1 Rienco Motor; 1 Rheostat, or speed regulator; 2 Small Dry Batteries and 10 feet of wire. Price, $1.00. Postage and packing, 30 cents. Send stamp for catalog.

Ithaca Electric Nov. Co., Inc. Box 64, Ithaca, N. Y.

BE YOUR OWN BOSS

MANY MAKE $2,000 A YEAR

You have the same chance. Start a Mail Order Business at home. We tell you how. Money coming in daily. Enormous profits. Everything furnished, Write at once for our "Starter" and FREE particulars.

P. M. Krueger Co., 155 Washington St., Chicago, Ill

COOK BROS.

Marine Motors

"The Best"

PEKIN, ILL. U. S. A.

ECLIPSE POCKET AMMETER

For General Battery Testing. 0 to 20 Amperes

Flexible cord attached and contact spur in case, which is DRAWN BACK INTO CASE, when carried in pocket. Size of watch and very light weight. Can be used in any position. Particularly designed for Auto use.

PRICE $5.00

ELDREDGE ELECTRIC MFG. CO.

227 Main Street, Springfield, Mass.

The World's Headquarters for

ELECTRIC NOVELTIES and SUPPLIES

If It's Electric We Have It.—We Undersell All

Fan Motors, $2.00 to	$15.00
Battery Table Lamp,	3.00
Battery Hanging Lamp,	10.00
Telephone, complete, $2.50 to	5.95
Electric Door Bells,	1.00
Electric Carriage Lamps,	5.00
Hylo Turn-Down Lamps,	.60
$8 Medical Batteries,	3.95
$12 Belt, with Suspensary,	2.50
Telegraph Outfits,	2.00
Pattery Motors, $1.00 to	12.00
Bicycle Electric Lights, $2 to	3.50
Electric Railway,	3.25
Pocket Flash Lights,	1.25
Necktie Lights,	1.00

SEND FOR FREE BOOK.

$3 ElectricHand Lantern. Agents wanted.

OHIO ELECTRIC WORKS, .. Cleveland, Ohio

Mounting a Wild-Cat.

We can teach you how.

LEARN TAXIDERMY BY MAIL.

WE CAN TEACH YOU to correctly mount Birds, Animals, Heads, etc. Taxidermy is indispensable to the sportsman and naturalist. Adapted to all persons inclined toward MECHANICS or ART. Easily and quickly learned. Learn in your own home during your spare time. Save your fine trophies. Decorate your home and office. Double your income. Best methods, reasonable tuition, highest references, satisfaction guaranteed. You may have our new illustrated catalog for the asking. WRITE TODAY.

The Northwestern School of Taxidermy, Suite 58 Com. Nat'l Bank, Omaha, Nebraska

We Mount Specimens RIGHT at RIGHT PRICES.

We successfully teach the profession of

PIANO TUNING

BY MAIL

By the new, scientific Tune-a-Phone method. Many of our graduates are earning $5.00 to $10.00 a day. Knowledge of music not necessary. *Write for Free Booklet.*

Niles Bryant School, 220 Music Hall, Battle Creek, Mich.

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,

127 NASSAUST. ROCKFORD, ILL., U. S. A.

A GOOD

Drawing Table

CASH WITH ORDER. PRICE, $5.00

Adjustable to height and angle. Top of hard or soft wood 20 x 28 inches. Shipped in the knock-down by freight. Weight 50 lbs. Circulars free of full line of Tables.

The Hetterschied Mfg. Wks.

317 S. Division St.

GRAND RAPIDS, MICH.

Columbia No. 1

DRAWING STUDENTS NEED THE DRAFTSMAN

25c for 4 months—Cleveland, Ohio

LOW PLUMBING BILLS

Get them by paying right prices for supplies. We sell

SUPPLIES AT WHOLESALE

You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.

B. P. KAROL,

220 W. Harrison St., Chicago.

MAIL SHIPS RACE AT SEA.

Stirring Times Driving a Mail Ship Below and on Deck.

Ocean racing to the average marine engineer will never lose any of its charm. It doesn't matter if he is in charge of the crankiest old bag o' tricks of a debilitated tramp or the intricate twin-screw engines of the liner of the present day, he cannot resist the temptation to try her powers against any rival that they may come across on the high seas of the world. It is astonishing to see the way two old tramp ships will plunge along, day after day, at their allowed speed limit of about 8 knots with no particular aim, perhaps, but to be the leader in an ocean race. But ocean racing is seen at its best on the fast mail ships, when getting the mail off, or the pilot, by quarantine, is the goal they are driving for. With about half a hundred men on watch in the engine and boiler rooms, all more or less imbued with the racing spirit, the mail ship can soon be raised from her usual speed to her speed limit, and held so for days, weather permitting of course.

As we have known for days that our rival was running abeam, about 15 miles to northward of us, we are not surprised when she appears over the horizon at noon heading like ourselves for New York. If outward appearance goes for anything, she betrays every symptom of a desire to get there ahead of us as she drives along with smoke rolling from her funnels and foam breaking from her bows. We accept the silent challenge and await with impatience the word to "let 'er go" which presently comes down the ladder. Soon the word passes through the boiler rooms, and with the increasing energy of the firemen the steam creeps up. The men gradually knock off jawing one another, as all their spare time is occupied in having a blow under the ventilator. The only sounds heard are an occasional sharp command, the clash of the furnace doors, or the rattle of the firing tools. The temperature of the boiler room rises, sometimes to about 130 degrees Fahr., and it is surprising to see how well the men hold out in this intense heat.

Presently the engineer steps into the bunkers, and running his eye over the coal points out the best coal for steaming purposes with the curt order, "Rush it out!" The coal-passers usually work in pairs, a novice being selected to work with an old-timer, if possible. Divested of all but their pants and shoes, skin black as ebony, and dripping with perspiration, they shovel and wheel. They also have succumbed to the prevailing excitement, and woe betide the luckless individual in the way of the loaded iron barrows as they emerge at a run from the bunkers and, dexterously shooting the coal out in front of the furnaces, are off again for another load.

In the engine rooms, where the monstrous four-crank engines are tearing round, the engineer in charge is even more on the alert than usual, as it would not do to have anything happen in a crisis like this. His eyes seldom leave the rows of gauges as he notes the various pressures recorded, his condenser vacuums and temperatures of his sea injection discharge, feed water, etc. Close to the levers is a telegraph to the bridge, a telegraph to the boiler rooms (humorously pointing to "more steam") and a telephone to the wheel house. From his position at the levers he sees but little of the machinery beyond the flying cranks, but his assistants and oilers making their reports keep him posted as to how things are running. Every half hour, perhaps oftener, he will take a note of the figures on the revolution counter and calculate the average revolutions since coming on watch. He notes with satisfaction each decimal point of a revolution gained,

and sends word to his colleague in the boiler rooms. He also sends a few caustic remarks if the revolutions are not increasing as time passes. He knows and understands the various sounds around him, as each piece of machinery has its own clank or beat, and any change from the usual would at once make itself apparent to his quick ear.

Over the auxiliary machinery the junior engineers keep the watchful eyes of a fond parent, as each individual pump is like the link in a chain, and a slight hitch can set the whole system wrong. The junior knows from bitter experience what a little two-hours' sweat on a broken-down feed pump means and, as he goes around, passes his hand over the various nuts and pins on the pump gear.

The latter two hours of the watch see us steaming our best, as we had about twenty fires to clean with their ash-pans and smoke-boxes after we came on watch.

"Eight bells" rings at last and we are by no means sorry to be relieved, as four hours is quite enough for any man.—American Machinist.

SOLID RUBBER TIRES FOR AUTOS.

Mr. J. M. Maclulich, an authority on rubber tires, in a paper read before the Institute of British Tire Manufacturers last week, made the assertion that properly constructed solid rubber tires in conjunction with good springs, such as are now fitted on all first-class motor cars, practically absorb as much vibration as pneumatic tires.

To this statement he adds that the advantages economically are much in favor of the solid class and that they possess the additional advantage of raising much less dust. A solid tire is also less liable to side slipping.

Before it is possible to use solid tires on a car that has been built to use pneumatic ones, it is necessary to make certain changes in the springs and spring hangers. Without these changes the driving of the car will be accompanied with unpleasant shaking that will prove disastrous to operator and car.

The Automobile says: In the manufacture of solid rubber tires the best ones are made out of pure Para rubber, in the washing and preparation of which fully 15 per cent is wasted. The tire must not be made out of pure rubber entirely, for if so it would be too soft to support the weight of the car and would be continually springing out of the rim channel. These tires are a composition, the major portion of which is pure rubber. At present there is not sufficient discrimination between good and bad solid tires. In the many cases the buyer being entirely ignorant of the differences that can exist in these tires, imagines that all solid ones are alike and so purchases with his eyes shut.

OF COURSE IT'S SO.

An old fellow from one of Portland's most remote suburbs, while passing a certain hardware store in that city the other day, noticed a sign which read, "Cast Iron Sinks." The old fellow chuckled softly to himself; then, gradually, as the absurdity of it dawned upon him more forcibly, he broke into a loud guffaw. A passer-by, attracted by the apparently unseemly mirth of the old man, made bold to ask what amused him so. "Why, gol durn it," he sputtered between spasms, "ef some folkses air not gettin' to be reg'lar durn fules. The idee uv hangin' up er sign tellin' people that 'cast iron sinks.' "—Lewistown Journal.

An enterprising undertaker, according to the Greenville (O.) Tribune, has invented an auto-hearse, and his daughter says "folks are just dying to ride in it."

The American Well Wks.

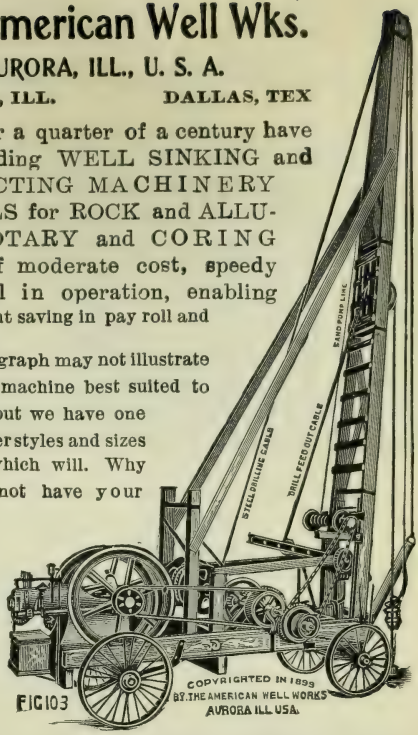
AURORA, ILL., U. S. A.

CHICAGO, ILL. DALLAS, TEX

For over a quarter of a century have been building WELL SINKING and PROSPECTING MACHINERY and TOOLS for ROCK and ALLUVIAL, ROTARY and CORING WORK of moderate cost, speedy economical in operation, enabling large per cent saving in pay roll and pipe bills.

This photograph may not illustrate the style of machine best suited to your work, but we have one hundred other styles and sizes some of which will. Why should we not have your orders?

We have pleased old customers, can please new ones.


STEEL DRILLING CABLE
DRILL FEED OUT CABLE
BAND PUMP LINE
FIG 103
COPYRIGHTED IN 1899 BY THE AMERICAN WELL WORKS AURORA ILL USA.

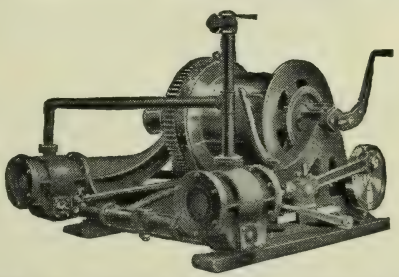
NEW AND SECOND-HAND ELECTRICAL MACHINERY

COMPLETE PLANTS INSTALLED.

Expert Electrical Repairers of Armatures, Fields and Commutators.

ILLINOIS ELECTRICAL MFG. CO.

1222 S. Adams St. : : : Peoria, Illinois



THE QUINCY HOIST

8 x 10	Cylinders, Drum 14 x 20,	$496
8 x 10	Cylinders, Drum 24 x 24,	$505
8 x 10	Cylinders, Drum 30 x 30,	$525

YOUR CHOICE; FRICTION OR REVERSIBLE

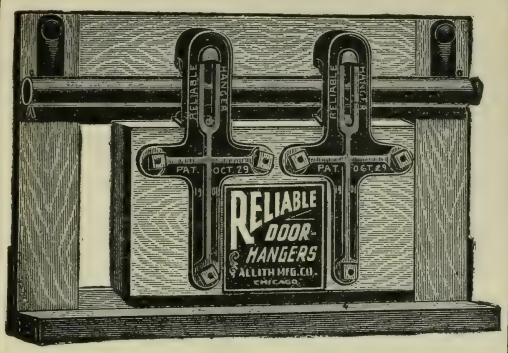
Delivery f. o. b. Quincy, Ill., or Chicago

No discount from above prices.
Will ship subject to inspection and approval.
Modern, Quick, Strong, Efficient. Just the thing for pulling up cars or for small mines. Got 'em in stock. Order one.

WILLIS SHAW, - - Chicago

SOLE DISTRIBUTOR

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks
Ours Will Not Bind
Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.

120 South Green Street, Chicago

The New

Popular Mechanics

PREMIUM LIST

Fully Illustrated
Is Now Ready

BOOKS FOR MECHANICS,
ELECTRICIANS, ENGINEERS
SHOP TOOLS OF ALL KINDS
SPORTING GOODS, WATCHES, ETC.

Something for everybody given for one or more new subscribers.

ADDRESS

Popular Mechanics
JOURNAL BUILDING, CHICAGO

ERRORS OF SCIENCE.

By J. G. Wait.

If science is the truth demonstrated, or known facts classified—there are no errors in science—and the errors are nothing more than the wrong opinions of some man or men who are termed scientists, because of their researches and study after truth.

A few days ago a scientist from Austria was reported to have weighed the sun's corona at Lick's observatory. Every newspaper had the report and the number of tons that this outer envelop of the sun weighed was given.

Now it is possible that the man is mistaken and that he measured the force of the electric vibrations sent out from this electric sphere—and not a volume of matter contained in the sun's corona.

For many years we have read of the great variations in the sun's corona, and that the flashes of light sometimes extend for hundreds of thousands of miles into space, while at other times not so far—that is, there is a variation.

Pictures of the corona represent it as something like the streaks or rays of light we see around our arc lights on the streets.

What are these rays but visible electric vibrations?

And as it is well known that we would not be able to see but for etheric vibrations (for light is a vibratory motion of the atmosphere set agoing by the sun's rays)—so is it not fair to conclude that the sun's corona is nothing more than gigantic electric waves—and not something that can be weighed like molten iron or other matter?

It is a scientific truth because it has been demonstrated that no atom of matter can be destroyed; hence, the theory held by many scientists, that the sun is a sphere of matter slowly burning itself up, is untenable. No atom of matter can be destroyed, else the universe would become unbalanced; so whatever the sun is, it is not going to be blotted out in time.

The sun—that glorious orb of day—is the cause of life, light, heat, and electricity upon our planet, and is, in the opinion of the writer, an electrical sphere absorbing from the universe as much energy as it gives. This is not a scientific truth—as yet only an opinion—but, if it accords with the truth, then it will become a scientific fact some time.

Science tells us that the earth's axis is inclined something like 23 degrees to the sun's axis, and that this is what causes our changes of seasons.

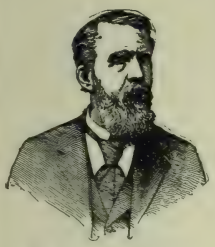
This is true; but nowhere have we seen an explanation of the reason why it is so inclined.

The reason is, because that part of the earth on what we call the north side of the equator, is loaded with a greater amount of land than the south side. The part of the earth south of the equator contains more water, which is lighter than the earthy matter to the north, and this is what causes the inclination—in our opinion. If the land was evenly divided, the axis would, no doubt, be parallel with that of the sun, and our seasons would be unchangeable, only one season like that at the equator. Now if a child should happen to ask why that land happened to be as it is we would be obliged to say because; or silence it by saying, it was decreed so by the Creator.

Pliable marble is a curiosity little known to the public. In the possession of Prince Borghese some time ago were six slabs of marble which could be bent at will. The peculiarity is believed to be due to the effect of fire. When placed on end they bend backward or forward; laid horizontally and raised at one end they curve; placed like a see-saw on a block of other material the ends droop. They are excavated at Mondragon, near Naples, and have a grain like Carrara marble.

STARRETT TOOLS

are the recognized standard for accuracy, workmanship, design and finish. Whether you use tools to earn your daily bread or for amusement and relaxation from a different vocation, it pays to use GOOD tools. You get a better quality of bread and a good deal more pleasure.



L. S. STARRETT

USE STARRETT TOOLS

We make hundreds of different tools. Ours is the largest plant in the world where nothing but fine mechanical tools are made. All these tools are fully described and illustrated in our Catalogue No. 17AP, which you may have by sending us your address. There is a good deal of valuable information in its 176 pages which it will pay anyone who uses tools to have.

THE L. S. STARRETT COMPANY
ATHOL, MASS., U. S. A.

AN INVESTMENT OPPORTUNITY

We Offer the Best, Strongest and Safest Investment Proposition Ever Offered to the Public

We are in the most profitable business known, the raising of rubber and other tropical products and cattle in Mexico, and in a business that will earn and pay to investors in this company larger dividends than would be possible in any other business.

We own five thousand acres of the most fertile land in Mexico, with two miles frontage on the Trinidad River, navigable at all seasons, and with immediate railroad connections; gives us the best transportation facilities to the great home market as well as the markets of the world.

Our land is especially adapted for the raising of all tropical products and cattle. Live stock feed and fatten the entire year. Two crops of corn and beans annually. Cheap labor and a great home market at high prices for our entire production.

We offer a limited amount of stock upon an easy payment plan, which makes an opportunity for you to make an investment that will be safe and at the same time earn annually large dividends for yourself and family for life.

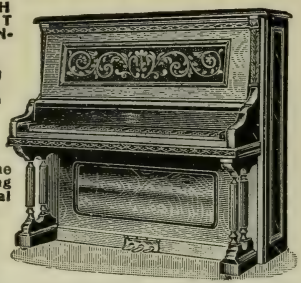
Write Today for our Booklet, "MARVELOUS MEXICO" and learn more about this Proposition

The Mexican Cattle and Plantation Co., Suite 1262 Monadnock Building

WONDERFUL PIANO OFFER.

The Celebrated BECKWITH PIANO CO.'S UPRIGHT GRAND 25-YEAR GUARANTEED PIANOS

$89.00, $115.00, 138.00, and 165.00.



For the most liberal piano offer ever heard of write for our **Free Piano Catalogue**, and you will receive by return mail, free, postpaid, the **handsomest, most interesting and most complete Special Piano Catalogue ever published.** We will send you a facsimile of our celebrated 25-year guarantee, our one year's free trial plan will be fully explained, how we furnish pianos on trial without one cent of money being sent to us will be made very clear; you will receive facsimile letters from the largest Chicago banks endorsing our proposition and we will explain just what the freight will be to your town. In the special catalogue we show large, handsome, halftone illustrations and complete descriptions of all the different parts, the manner of construction (interior and sectional views), also color tone sample plates of the different woods, including French burled walnut, English quarter sawed oak, San Domingo figured mahogany, etc. Each piano is shown in very large halftone, full plate illustrations, every detail is fully and accurately described. **Why the highest grade Beckwith Piano made, the Acme Cabinet Grand Concert Piano at $165.00, is in every essential point the equal of any piano made, regardless of price, is made very clear. Write for our Free Piano Catalogue** and get all this free by return mail, postpaid; our latest and most astonishing offer, the greatest piano proposition ever heard of. If you have any use for a piano at any price, don't fail to write for **our Free Piano Catalogue and Offer.** Address, **SEARS, ROEBUCK & CO., CHICAGO, ILL.**

$10.50

Buys this $21.00 Lewis Orchestra No. 1 Violin : : :

Our standard for professionals and high-grade amateurs; easily worth $25; listed by us for YEARS at $21. In our new catalogue, we are now offering TO YOU DIRECT the full teacher's and all dealer's (50 % Off) discounts on violins, guitars and other stringed instruments. Values from $3.50 to $125.00 and upward. Write for our catalogue and inquire also about our great

FREE TRIAL OFFER

WM. LEWIS & SON, (Est. 1869)

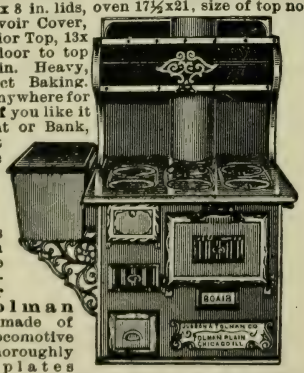
Largest and oldest exclusive stringed instrument house in the U. S.

211 C Wabash Avenue, Chicago

☞Specialty in strings for professional trade.

$45.00 TOLMAN Steel Range 23.75

Exactly as shown with **15 Gal. Reservoir and Hi Closet.** Six 8 in. lids, oven 17½x21, size of top not including Reservoir Cover, 28x36 in. Reservoir Top, 13x 24 in., height, floor to top High Closet 55 in. Heavy, Durable, Perfect Baking. We ship range anywhere for examination. If you like it pay R. R. agent or Bank, $23.75 and freight and take range home for



30 Days Free Trial

If not exactly as represented in every way, we **cheerfully return your money. Tolman Ranges** are made of best Wrought Locomotive Steel Plate. Thoroughly rivited. Oven plates braced. Flues lined with Asbestos. Burn any kind of fuel ***Guaranteed Five Years*** Will save their cost in one year. We deliver exactly what we advertise. Send order, or send for our Catalogue E today,

JUDSON A. TOLMAN COMPANY
Dept. W-70. 66 Lake Street, Chicago

CLEANING MILK VESSELS.

Milk should always be rinsed out of vessels before they are scalded. If this is not done, the albumen of the milk will be coagulated by the heat and adhere to the sides, making its removal difficult. It is important, therefore, not to have the first wash water too hot, says Hoard's Dairyman. Cold water is sometimes recommended, but this is not necessary, as it may be quite warm without changing the condition of the albumen. The best practice is to rinse the vessels with cold or warm water, then wash in hot water by the aid of some cleaning preparation, then rinse carefully and enough to remove all soap, salsoda or other cleaning material, and finally sterilize in a steam chest, exposing them to live steam about three minutes. The methods generally used in washing milk vessels are very imperfect. The vessels are often carelessly rinsed with cold water, then one is filled with hot water and cleaned with a cloth, the same water being made to serve for other vessels successively, being turned from one to another, and by the time the last is reached, the water is no longer hot and is decidedly milky. When water is not hot, the grease is not removed, but simply smeared over the tin. Two wash-sinks should be close together, one for the general cleaning and the other containing clean, hot water in which each article is rinsed as soon as it is washed. Most utensils easily dry after being steamed, but if they do not they may be put in a drying room or wiped with a clean cloth. They should be placed in pure air, and in sunshine if convenient. though this is not necessary, if well cleaned and thoroughly sterilized.

HORRORS OF BERI-BERI.

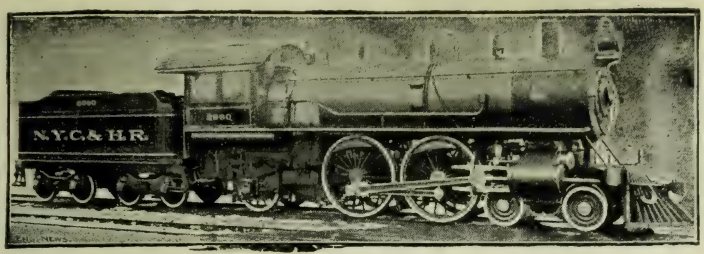
Beri-beri, the disease peculiar to India, formerly known as "the bad sickness of Ceylon," as so many cases of it existed there, is said to be the most terrible disease known to mankind. It even exceeds in horror the Bubonic Plague, because death is more tardy in coming to the sufferer's relief, says the Western Undertaker. It is characterized by great weakness, numbness and inability to make proper use of the limbs. The entire body becomes a nervous, shaking, trembling wreck, involuntarily assuming all sorts of postures, both grotesque and horrible; groveling attitudes like those of beasts and reptiles. The expression of the countenance is beyond the patient's control, and the most hideous grimances, as in St. Vitus' dance, only worse, distort the features. To witness them is painful in the extreme, and it affects the beholder to such an extent that but few are brave enough to stand by the afflicted in the effort to give relief. Whenever this disease breaks out in an Indian town, the natives become utterly demoralized, so great is their terror. The treatment usually given is brisk rubbing and stimulation, but there is, in but few cases, scarcely a particle of hope for the victim's recovery, from the first moment of attack. Some British physicians are giving the malady special study and attention, in the hope of discovering a remedy

WIRE-WOUND WOODEN PIPE IN DEMAND.

Since a Canadian company installed a plant for the manufacture of wire-wound wooden pipe there has arisen a great demand for it, as it is claimed to be much superior to iron pipe for water supply purposes and can be furnished at less than half the price. It is not so heavy to handle and is less liable to burst upon freezing than iron pipe. Mill owners and mining engineers are using it instead of flumes with a resultant saving in water and repair. L. Edwin Dudley, U. S. Consul at Vancouver, B. C., reports that 30 or 40 carloads of the pipe have been shipped to various Canadian territories.

ELECTRIC RAILWAYS

Perfect Working Models of Locomotives, Trolley Cars, Interurban Railways, Dynamos, Motors, Gas Engines, Castings, etc.



We carry the most complete line of Electrical Novelties and Experimental Apparatus. Everything for the Amateur Electrician.

Write for our New Catalogue "B No. 9."

THE CARLISLE & FINCH CO., 262 East Clifton Avenue, CINCINNATI, OHIO

Glogau's Alcohol-Gas Stove

Can do everything a gas stove does. **Indispensable** for nursery, sick room, Chafing Dish, shaving; for tourists, boarders, hunting, fishing, or **wherever gas is not available or desirable.** Vaporizes alcohol into gas, increasing **its efficiency 8 times.** Portable, weighs but 8 ounces. **Consumes but 2 cts. worth** of alcohol **an hour.** Will boil quart of water in 9 minutes. Smokeless and odorless. Reservoir holds half a pint. Uses either wood or grain alcohol. Simple; cannot get out of order. Safe; will sustain weight of 100 lbs. Extinguishes instantly (blows out like a candle). **Non-explosive.** Solid Spun Brass and **NICKEL PLATED.** Sent anywhere, postpaid, **$1. Agents Wanted.**

P. M. GLOGAU & CO., 40 Dearborn St., Chicago.

"IF SLEEPING, WAKE,

If feasting, RISE before I turn away." It is the hour of FATE 'Tis

OPPORTUNITY

the ruler of human destinies, that speaks
Of many books there's ONE YOU NEED
'Tis unpretentious, and its name?

"A Guide to Full Pockets"

That's what most mortals need and if thy needs are common with the rest, **here** is the mystic **key to fortune, fame and joy.**
'Tis FREE, for fortune's smiles can ne'er be bought. Thousands have read and quickly grasped the offered boon. **'Tis now thy turn**—this call the **last to you.** If heeded not you'll seek in vain for that which will return no more. Send thou a postal card and we will tell thee all.

THE NUTRIOLA CO., 142 W. Madison St., Chicago, Ill.

Mysterious CHANGING CARDS

With these cards you can do the most wonderful tricks. You can make trays fade into blank cards, blanks into aces and aces into deuces, etc, No practice necessary. Send for a pack and be a real wizard. **PRICE ONLY 10C., POSTPAID,** with full secret direct'ns. Address **WESTERN SPECIALTY CO., 532 E. Minnehaha St. St. Paul, Minn.**

25c BOOKS

on Electricity, Mechanics and other subjects. Send for descriptive LIST FREE

SPON & CHAMBERLAIN, PUBLISHERS, DEPT. P. M., LIBERTY BLDG., NEW YORK

Are You a Lover of

Good Tea and Coffee

We are making a Special Proposition to those who enjoy a beverage that is not only delicious, but more appetizing and nutritious than any other tea and coffee on the market.

THE GREAT AMERICAN TEA COMPANY

Write for **Special Christmas Proposition** to persons getting up clubs or sending orders of $5.00 and upwards.

It is worth your while, as we intend to use unheard-of efforts to increase the number of customers during the next two months.

This offer applies only to readers of Popular Mechanics

Write us at once—to-day—to

MR. CARL,

Great American Tea Co.,

31 & 33 Vesey St., P. O. Box 289, New York

$40.00 A WEEK.

Reliable man or woman each county as manager to exhibit, take orders, appoint agents for **Harrison Valveless** Oil-Gas Stoves. **Wonderful invention** — beats others — Automatically generates fuel gas from kerosene—**Miniature gas works**—Absolutely safe—Enormous demand—**Splendid for summer cooking**—Delight customers—Cheap, clean, safe fuel. **Gasoline is dangerous. Catalogue Free.** Write today. **WORLD MFG. CO., 5687 World B'ld'g., Cincinnati, O.**

KANSAS OIL

Stocks in well managed companies properly organized and having good prospects

WILL MAKE YOU RICH

If you get in early while the stock is selling at a low price.

You will never see a better opportunity to invest in Oil than right now, while the Kansas Oil Fields are being developed.

The Anchor Oil and Gas Co. owns 320 acres of the **best oil lands** in Kansas and will sell some of its treasury stock for the express purpose of developing the property.

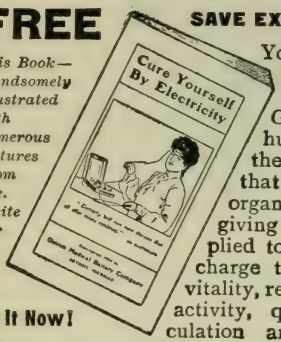
We believe you will see big dividends and a sharp advance in price of the stock within a very reasonable time. This company certainly has great possibilities. If you want to make big profits, write today for our **Special Offer,** and ask for "Anchor" prospectus free.

UNION SECURITY CO.

461 Gaff Bldg. Chicago, Ill

"CURE YOURSELF BY ELECTRICITY"

FREE **SAVE EXPENSE—KEEP WELL**

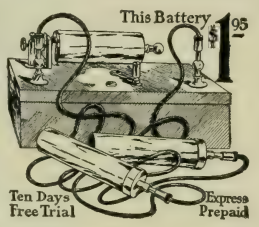


This Book—Handsomely illustrated with numerous pictures from life. Write for it.

You should have this book—It's free—Sent to all who write. Gives a diagram of the human body, showing the great nerve centers that controls the vital organs. Tells why the life-giving electric current applied to certain centers will charge the nerves with new vitality, restore organs to normal activity, quicken sluggish circulation and develop muscle; quickly curing **Rheumatism, Neuralgia, Lumbago, Headache, Insomnia, Constipation** and all **Nerve Affections** and diseases arising from **poor circulation.**

Do It Now!

This book shows how you can do it yourself at home with one of our New Home Batteries (price $1.95 to $11.35) and their various attachments. It also shows how they afford the celebrated Electric Baths and Beauty Massage without extra cost.



We send our batteries **Express Prepaid,** without a cent in advance, and allow **Ten Days Free Trial.** Write today for our Free Book.

DETROIT MEDICAL BATTERY COMPANY
1139 Walker Block, Detroit, Mich.

STEVENS

There is no use in wondering what firearms to obtain as long as the **"STEVENS"** maintain the supremacy they have enjoyed for almost half a century. Ask one of the vast army of shooters who use our products, what he thinks of the **"STEVENS."** You will then be surely added to the innumerable hosts who are equipped with this popular make the world around.

We manufacture a varied and extensive line of

RIFLES, PISTOLS, SHOTGUNS

Ask your dealer for our products, and insist on getting them. If you cannot obtain the "STEVENS" let us know, and we will ship you direct, express prepaid, upon receipt of price.

Don't fail to send for 136 page illustrated catalog.

Mailed for 4 cents in stamps to cover postage. An invaluable book of ready reference.

Have you tried that new puzzle of ours? It is an attractive and interesting novelty, and we shall take pleasure in forwarding same to any address upon request.

J. STEVENS ARMS & TOOL CO.
40 Main St., • Chicopee Falls, Mass., U. S. A.

HOW TO TELL LINEN FROM COTTON.

The surest way to distinguish linen from cotton goods is by the aid of the microscope. So successful are the adulterations of linen in America that no firm or corporation has ever considered it worth while to produce flax in this country although ex-

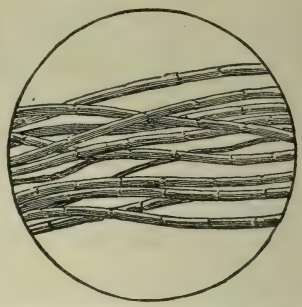


Fig. 1. Microscopic Reproduction of Flax Fibre

periments have shown that just as fine can be raised in this country as anywhere.

Not one spool of linen thread for manufacturing purposes has even been produced in the United States; not one piece of goods in a thousand sold as pure linen has a thread of linen in it, not even the merchant, who does not use the microscope, can tell cotton goods from linen goods. The supply of linen is running shorter every year and the only

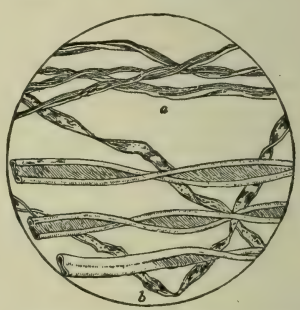


Fig. 2. Microscopic Reproduction of Cotton Fibre

way to satisfy that class of people who demand pure linen at any cost is to make a superior imitation out of cotton.

An expert says: Under the microscope we find that the linen thread is composed of a large number of fibers, each about two inches long. Each fibre is a straight hollow tube more round than flat. This tube is divided into joints very much like a stick of bamboo. The cotton thread is divided into a much smaller number of fibers, which look like twisted ribbons and have no joints. They are hollow like the linen, but are of much less strength, the proportion being about twelve to seven, and when woven into cloth about three to two.

A VALUABLE CATTLE FOOD.

The pulp left from beets after the juices had been extracted from them at sugar factories was thrown away as utterly useless until a Nebraskan farmer, being short on feed, began to feed it to some unthrifty young cattle. The cattle began to fatten up and increase in value and a scientific investigation followed. Now beet pulp is considered a high-grade feed for cattle and not a pound of it is wasted.

The Overland Limited

California

the most luxurious train in the world, leaves Chicago 8:00 p. m. daily. Less than three days to San Francisco, Magnificent equipment. Electric lighted throughout.

THE BEST of EVERYTHING

Two other fast trains leave Chicago 10 a.m. and 11:35 p. m. daily, with through service to San Francisco, Los Angeles and Portland via the

Chicago & North-Western, Union Pacific and Southern Pacific Railways

All agents sell tickets via this route.
Illustrated booklets on application to
W. B. KNISKERN, CHICAGO, ILL.
or E. L. LOMAX, OMAHA, NEB.

OL16

POPULAR MECHANICS

SHOP NOTES

∴ 128 PAGES ∴
204 ILLUSTRATIONS

* * *

Easy Ways TO DO Hard Things

* * *

Bound in Cloth - - $1.00
Paper Covers - - - - .50

SENT POSTPAID ON RECEIPT OF PRICE

POPULAR MECHANICS
Journal Building Chicago, Illinois

INDUSTRIES

ARE

OFFERED

LOCATIONS

WITH

Satisfactory Inducements
Favorable Freight Rates
Good Labor Conditions
Healthful Communities

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.

AND THE

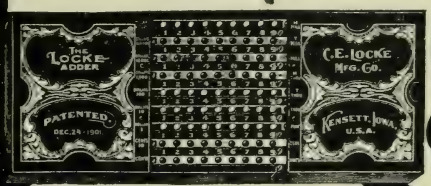
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet, address

J. C. CLAIR
Industrial Commissioner
1 Park Row, - - - Chicago, Ill.

A Modern Adding Machine

that adds as fast as those costing hundreds of dollars. All metal model, price $5.00.



The Locke Adder

minimizes time, expense and drudgery of business details. It adds, subtracts, multiplies and divides. Computes nine columns at once. Cannot make a mistake. Mechanically perfect.

No complicated mechanism to get out of order; no expert repair man's bills to pay; no breaks to cause delay and inconvenience. Ready to use any time, any place. Simple, light, handy. Size 4 x 10¾ inches. Write today for **FREE** descriptive booklet. Agents wanted.

Capacity 999,999,999

C. E. LOCKE MFG. CO.
98 Walnut St. Kensett, Iowa

See our Exhibit, Liberal Arts Building, St. Louis Exposition.

WE MANUFACTURE

STAPLE GOODS AND SPECIALTIES

IN CAST BRASS
AND SHEET METAL

Estimates Furnished from Models or Blue Prints — Correspondence Solicited

FROST MANUFACTURING COMPANY

37-53 SOUTH PLEASANT ST. : : : : : KENOSHA, WIS.

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.
HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm. Address
210 Revenue Building • • WASHINGTON, D. C.

FORTUNES REALIZED FROM INVENTIONS.

"Little things" have brought fortunes to many an inventor. The once popular toy known as "Dancing Jimmy" yielded its inventor a $75,000 income yearly. The sale of another toy, "John Gilpin," brought its inventor $100,000 a year. Mr. Plimpton, the inventor of the roller skates, made $1,000,000 out of his idea. When Harvey Kennedy introduced the shoe lace he made $2,500,000 and the ordinary umbrella benefited six people by as much as $10,000,000. The inventor of the Howard patent for boiling sugar in vacuo realized an income of $250,000 per annum. The millions Sir Josiah Mason realized from the improved steel pen he gave to English charities on his death. The patentee of the pen for shading in different colors made $200,000 a year out of it. The wooden ball with an elastic attachment brought $50,000 a year to its inventor. The metal plates formerly used for protecting the soles and heels of shoes from wear made $1,150,000 in a year. The woman who invented the modern baby carriage made $50,000. A young woman living in Port Elizabeth, South Africa, yet realizes $500 a year from the invention of the Mary Anderson curling iron. The wife of a clergyman made a fortune from the invention of the modern woman's corset. A little girl who invented the screw-pointed gimlet made millions. Miss Knight, who invented the machine for making paper bags, refused $50,000 for it shortly after taking out the patent, and realized a princely fortune for the exceptional ingenuity her conception reveals.

"Herbert has been running an auto so long that he has forgotten all about horse-back riding."

"What did he do when the horse balked?"

"He crawled under it to see what was the matter."—Cleveland Plain Dealer.

A TOWN OF INVENTORS.

New Britain, Conn., is the home of the American inventor. Here inventing is the large source of revenue, and without this enterprise the town would be like Niagara if Niagara Falls should dry up. A large percentage of the inventive genius of America and of the world is to be found within the confines of Connecticut and the invention center of Connecticut and of America is New Britain. What Paris is to the art world, Wall street to the financial world and Chicago to the provision world, is New Britain to the inventive world.

WE CAN MANUFACTURE ANYTHING IN

Brass, Aluminum, Phosphor-Bronze or Gun Metal

We also manufacture Refrigerators, Beer Pumps, Faucets and Supplies.

Our Prices are reasonable. Write us.

U. S. SPECIALTY MFG. CO., - 33 Washington St., Chicago

"WE ANALYSE EVERYTHING"

AT REASONABLE RATES

Should you want to know what is contained in any preparation or product, address

THE ELLSWORTH LABORATORIES

MAX D. SLIMMER, Ph. D.

357 DEARBORN STREET, - - CHICAGO

PATENT YOUR IDEAS

$100,000 offered for one invention; $8,500 for another. Book "How to Obtain a Patent" and "What to Invent" sent free. Send rough sketch for free report as to patentability. We advertise your patent for sale at our expense.

CHANDLEE & CHANDLEE, Patent Attorneys

918 F Street, Washington, D. C.

Patents, Metal Specialties, Novelties, Tin and Aluminum Boxes

We make them all and anything in the metal line---Punches and Dies---Special Tools and Machinery---Boxes of special design and patterns; also experimental work at reasonable rates. All work guaranteed.

GREENLEAF & BACON, : : 42 and 44 Michigan Street : : Chicago, Ill.

PATENTS

Counselor in Patent Cases, Solicitor of Patents. Opinions furnished as to the scope and validity of Patents.

Chas. W. LaPorte

428-29 Woolner Building, - - - PEORIA, ILLINOIS

SPECIAL MANUFACTURING

Dies and Stamping

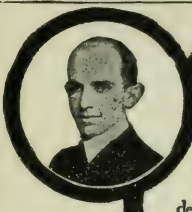
--TO ORDER--

SPECIAL MACHINERY, MODELS
EXPERIMENTAL WORK

DROP FORGING DIES AND DROP FORGINGS

Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.

THE GLOBE MACHINE & STAMPING CO.
973 Hamilton St., - Cleveland, Ohio



If you wish to buy or lease on royalty, patents on hardware or mail-order specialties, machinery, in fact anything, write to me.

INVENTORS

desirous of selling their patents quickly and to the best advantage should register with me. I can save you time and money.

I SELL PATENTS

CHARLES A. SCOTT,
796 Mutual Life Building,
Buffalo, N. Y.

MODELS AND SUPPLIES

Send for Illustrated Catalog of Appliance for Models

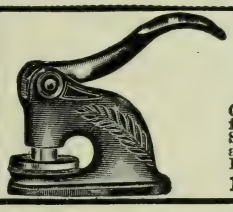
J. WEINERT & CO., 134 Pierce Avenue, Chicago

IDEAS PATENTED

May Bring a Fortune.

Fee refunded if unsuccessful. Write for free Booklet on Inventions. Send rough sketch for free report as to patentability. Patents obtained by me advertised free in Chicago papers.

JOHN L. KINDT
Patent Attorney, 31 Randolph Street, CHICAGO



J. W. Middleton & Co.
PUBLISHERS OF
THE INTER-STATE CORPORATION RECORD
Containing all Forms and Blanks for Organizing a New Corporation Stock Certificates, Bonds, Corporate and Notarial Seals, Blank Books, Printing, Lithographing
165-167 Dearborn St. Chicago

NAME PLATES, TRADE MARKS

THE MEYERCORD CO. INC.
DECALCOMANIA TRANSFERS.
NAME PLATES TRADE MARKS AND ORNAMENTS.
OPALESCENT TRANSFER WINDOW SIGNS.
CHAMBER OF COMMERCE BLDG. CHICAGO.

TRANSFER WINDOW SIGNS

WANTED

Hardware novelties and other articles of merit. Must be good sellers. Will buy outright or sell on a royalty basis.

The Cleveland Sales Co.
407 The Arcade - - - Cleveland, O.

HARDWARE AND METAL SPECIALTIES
Manufactured on Contract

PUNCHES AND DIES
SPECIAL TOOLS
GEAR CUTTING

CRAIG MANUFACTURING CO.
39-43 West Washington St., Chicago, Ill.

MODELS

CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES

ESTABLISHED 1867

Novelties Made to Order

we'll show you how to place your invention on the market and make money.

Metal Stamping

We make Dies and Tools that will turn work out cheaply. Write us—

CHICAGO RIFLE MANUFACTURING CO., 11-21 SO. JEFFERSON ST., CHICAGO

Beautify Your Window Display

WITH

OUR WALKING LADY

This figure travels around in your window, walking as natural as life. We furnish life-like mechanical figures, either head, bust or life size.

The descriptive article on page 1011 of the October issue of Popular Mechanics, in which no name or address was given, had reference to the

MECHANICAL FIGURE COMPANY
170 Madison Street, Chicago
Estimates, Prices, and Illustrations upon Application

Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE

W. L. STEBBINGS

Civil and Consulting Engineer
LICENSED ARCHITECT

Monadnock Block, - - - Chicago

Tel. Harrison 1104 **Cable Address "Stebbings" Directory Code**

AGENTS WANTED Sell our $1.00 bottle of Sarsaparilla for 35c; best seller; 200 per cent. profit; write today for terms and territory.
F. R. GREENE, 116 Lake Street, Chicago

Since the United States patent laws were enacted 1,447 inventions have been patented by 344 New Britianers. The offices of the New Britain patent lawyer are an interesting spectacle almost any day of the week. Here one finds many geniuses, queer and otherwise. Justin A. Trout, with a record of 121 patents, is one of the most successful of New Britain inventors. He has made a fortune out of seeming trifles. George E. Adams has 66 patents. It is almost impossible for a man or woman to dress without using some of his inventions. Suspender buckles, hose supporters, garter fasteners, corset steels, hooks and eyes, glove clasps, shirt studs, collar buttons and such things he has invented galore. Fifty-one devices have been patented by Thomas E. Corscaden. Among them in all probability are the handles of the coffin in which you will be buried, and similar grewsome, though necessary devices. Henry G. Voight has patented 44 contrivances for the protection of life and property. He is a man of padlocks and door knobs and latch keys and window fasteners. "Chris." Downey, of Waterbury, has invented 28 different things, his latest being a "football squawker and whisky bibaculator." It is a kind of whistle which holds whisky. At a football game the owner of the device may take a drink of whisky and his companion may think he is only blowing his squawker. It is strange that in the list of New Britain patentees there are but few women. Sarah Jane Wheeler patented a curry-comb; Elizabeth Minier is the inventor of a fruit jar cover fastener; Alice M. Hobson owns a patent for a steam cooker and Frances E. Maisonbille devised a meat tenderer that brought her considerable revenue.

JAPANESE WAR POSTALS.

An Ingenious Idea of the Mikado's Government.

The Japanese Government has found a novel and excellent use for post-cards. Realizing that, for various reasons, the soldier on campaign may not have leisure or opportunity to write home to his family, the military authorities have supplied to each army a sufficient number of post-cards, ready printed, to which the soldier has only to affix his name, or, more exactly, his seal, each Japanese soldier carrying one with him as part of his outfit. On all the cards the same message is printed: "This is to let you know that I am alive and well. I cannot give you my address, not knowing where I shall be tomorrow; but your letters will reach me sometime or other if you reply to the place, the name of which is printed in the postmark. Greetings to my family and friends." This is an idea which might well be copied by other nations, says a writer in the Manchester Guardian. At once practical and humane, it would cost little and save many thousands of people from unnecessary anxiety and pain.

If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

POPULAR MECHANICS CO.

CRANE FITTINGS
ESTABLISHED 1855

POPULAR MECHANICS

Vol. 6. No. 12. CHICAGO, DECEMBER, 1904. 10 Cents a copy. $1.00 a year

The Truth About The Flying-Machine

Difficulties to be Overcome--Limitations of the Air-Ship--Practical Navigation of the Air Not Yet Solved

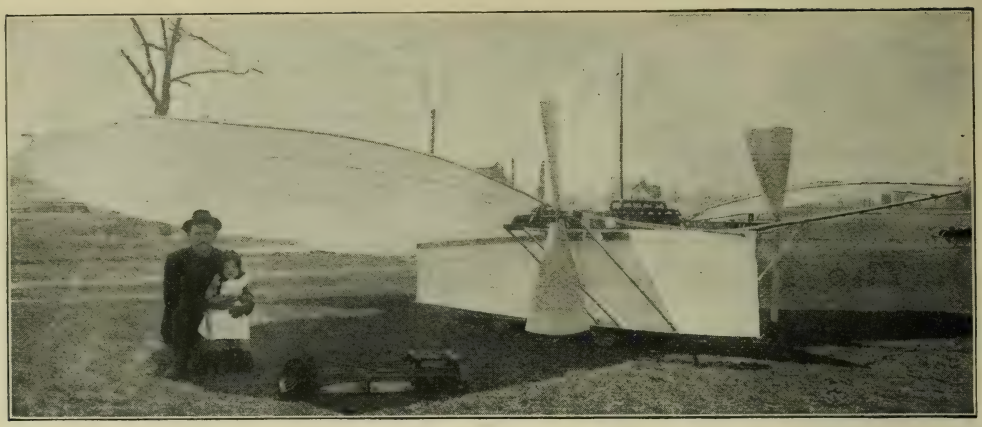
By C. H. Claudy

The announcement of a prize of $100,000 by the St. Louis Exposition, to be awarded the most successful air-ship or flying-machine exhibited, has caused an unprecedented interest in the greatest of all unsolved problems of transportation. Hundreds of inventors have been and are at work on models of various devices, many of them men who know absolutely nothing of physics, aerostatics or meteorology and who are, therefore, doomed, in advance, to ignominious failure. Every now and then some one succeeds in getting up in the air a balloon and propelling it, with more or less success, against the wind by means of a gasoline engine or other power source, and the claim is then heralded forth, from one end of the world to the other, that the problem has been solved.

This problem, however, is entirely different from the popular understanding of it. Air-ships and flying-machines are, to many, synonymous terms, while, as a matter of fact, they are as widely different as sailing vessels and submarine boats. The air-ship, like the water-ship, is a structure sufficiently light to float in a supporting medium and provided with a means of propulsion, the only function of which is to move the fabric and not in any way to support it. Unlike the water vessel, however, the air-ship has only one medium in which to work, while the boat has two.

Santos Dumont's Air-Ship No. 10

The flying-machine is a structure heavier than its supporting medium and is designed to support itself in the air by the exercise of power generated by apparatus contained in the machine. There is still a third and, perhaps, even a fourth type of aerial vessel, which has, as yet, no distinctive name. For example, a balloon having only sufficient gas to balance the weight of the fabric



Gustave Whitehead and His Flying-Machine—A Partial Success

against the attraction of gravitation and depending upon its own power for propulsion up into the air as well as propulsion forward and back. Such a machine might be termed a flying air-ship. The fourth class of aerial vessels would consist simply of a kite-like structure and is designed only for short and intermittent flights. Such structures are usually termed aeroplanes. This term is not distinctive, inasmuch as all flying-machines are provided with wing-like extensions which are called by the same name.

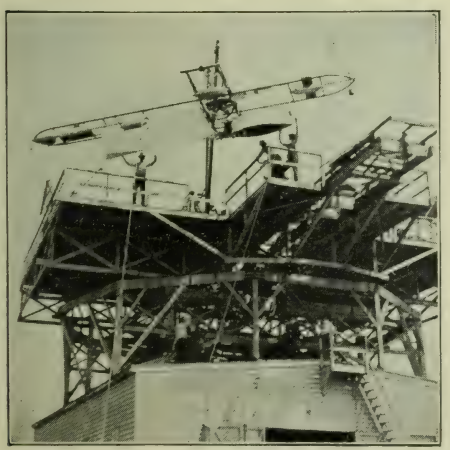
It is impossible, within reasonable limits of space, to attempt to describe the hundreds of individual attempts which inventors are fathering the world over. The enterprise must be looked at in a general way. The air-ship itself is now an assured success. Santos Dumont, Count Zeppelin, Doctor Greyth, Mr. Lee Stevens, the Lebaudy brothers, and a host of others, have successfully navigated the air in a mechanically propelled cigar-shaped balloon. Commercially, of course, the air-ship is not developed. It is, as yet, a most expensive and dangerous pleasure-craft and, in proportion to its size, can carry less weight and passengers than the smallest ocean-going craft. Whether or not it will ever become a commercial success depends almost entirely on the invention of a motor, the power of which will increase in a greater ratio than the weight. If it were possible, for instance, to construct an engine which would deliver one horsepower for every pound of engine, the public generally would be flying around now in the air as do the owners of automobiles upon the ground. Inventors who are wasting time and money on the construction of new shapes of balloons could very much better devote their time and energies to the simplification of the gasoline motor, or the discovery of some new means of generating force from an apparatus which would weigh but a few pounds to the horsepower.

Hoisting the Langley Machine to the Launching Stage

The flying-machine is the most misunderstood of the various factors connected with the problem of aerial navigation. The recent unsuccessful attempts of Prof. Langley, of the Smithsonian Institute, have, unfortunately, most unjustly been made a subject for many ridiculing remarks on the possibility of mechanical flight. Both Sir Hiram Maxim, in 1894, and Prof. Langley, in 1896, demonstrated, both in theory and practice, the possibilities of mechanical flight of a fabric heavier than air.

Prof. Langley has spent nearly twenty years in the investigation of the problem, using the most approved scientific methods to determine the almost hundreds of points necessary to understand before ever attempting to build a flying-machine. In 1896, after repeated unsuccessful trials, he succeeded in launching a model flying-machine over the Potomac river, which, twice in succession flew over one-half a mile. This model was propelled by steam, and its flight was circumscribed by the small amount of boiler-water it could carry. Since that time Prof. Langley has been working upon his larger air-ship, in which Mr. Manly, his assistant, twice attempted flight in October and November of 1903. That the attempts were both unsuccessful might have been due to a hundred causes. Inasmuch as it took Prof. Langley fifteen years to get his model in running order, it is by no means to be understood that because of one or two, or half a dozen, unsuccessful attempts with the larger structure, the machine or the principle is a failure.

Without going too much into the technicalities of the subject, a few words may here serve to explain the elements of the principles on which the aeroplane flying-machine of Prof. Langley is constructed. In the first place, it is a well-known law of physics that could sufficient speed be imparted to a projectile it would never fall to the ground, but would continue to circle the earth for an infinite period. Everyone knows that the harder a missile is thrown, the further it will go. The reason is very simple. Two similar bodies released from



Getting the Langley Machine over the Edge of the Launching Stage

Ballooning in Paris, A Popular Sport

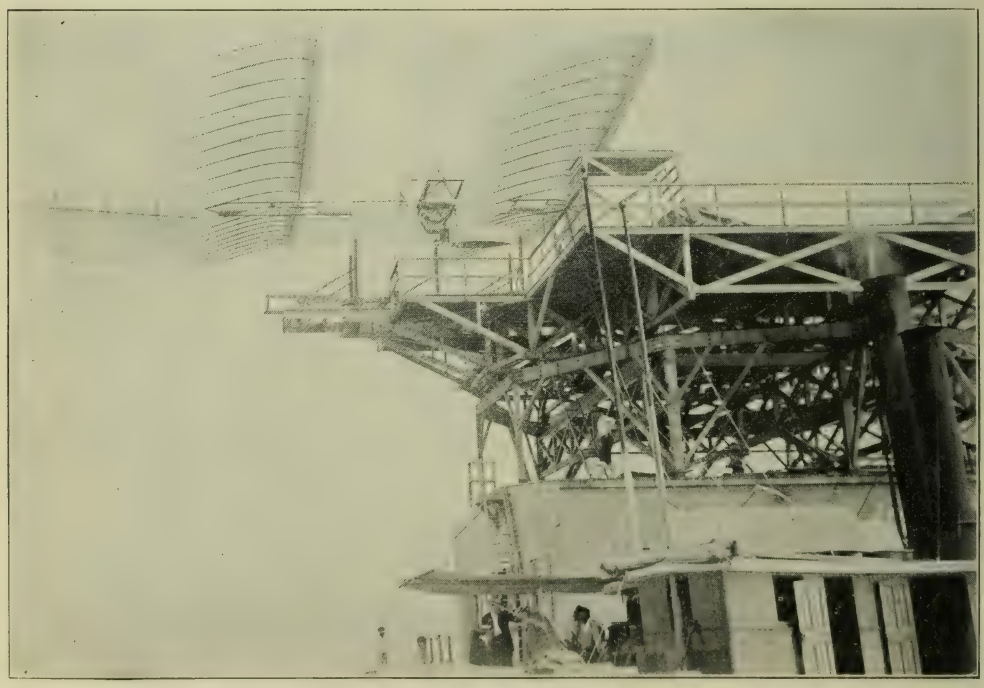
support at a given height will fall to the earth in the same time, regardless of whether one is moving forward and the other stationary. If a man stands on the top of a house and throws a stone with one hand and drops another stone with the other hand, the two stones will reach the earth at the same time, providing the stone which was thrown was projected from the hand in a horizontal direction. Another well-known fact which illustrates one of the principles of Prof. Langley's machine is that a skater can propel himself over very thin ice, providing he goes fast enough, when the same ice would not support his weight if he were stationary. One-half an inch of ice might support a weight of one hundred and fifty pounds for perhaps one-half a second. If, however, that one hundred and fifty pounds within that one-half second can be distributed over twenty feet of ice, the weight is as secure from breaking through as if it were stationary on a piece of ice ten inches in thickness. To return now to Prof. Langley's machine, it can be regarded

as a stone which is flung into the air, and which, by means of its propellers, keeps propelling itself with a force equal to the initial throw. The aeroplanes, wing-like structures, have a slight tilt from stern to bow, so that their action when rushing against the air is at once similar to that of a kite and to the skater who is distributing his weight over a large surface of ice. The flying-machine, which would not be supported by its wings for more than a fraction of a second if stationary, by distributing its weight over many columns of air within a second, succeeds in maintaining its place with only a slight drop. This slight drop is overcome by the upward tendency of the entire machine by the kite-like action, which, in turn, is caused by the slight upward tilt of the aeroplanes when drawn against the air.

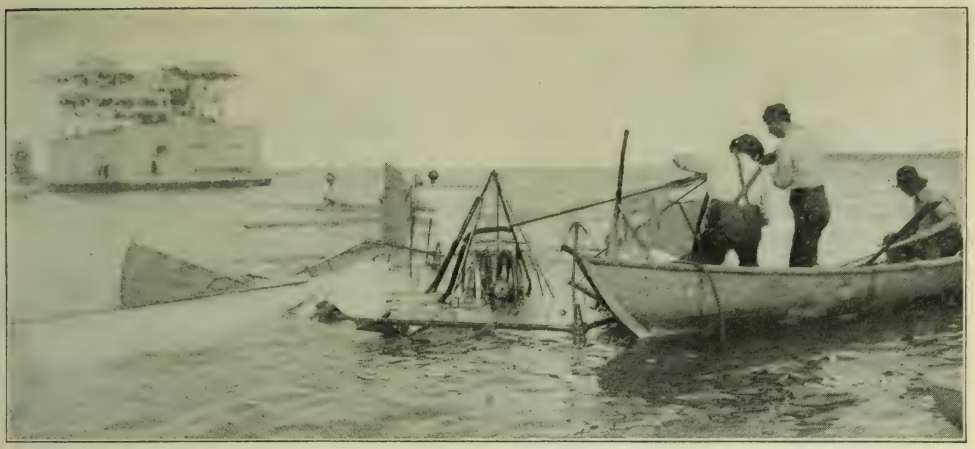
There is another factor which enters into the construction of such a machine as the one under discussion, which is known as Langley's Law. This law is to the effect that within certain limits, the faster the flying-machine is being propelled through the air, the less power is required to maintain the speed. It would be very difficult to demonstrate without recourse to mathematics of a puzzling and abstruse character the practical proof of this law. That it is accepted, with certain exceptions, by the scientific world is due to the exhaustive experiments made by Prof. Langley with his whirling table, a device for the study of captive aeroplanes.

Of course there are an immense number of little adjustments—balancing mechanisms, rudders, the proper places for the propellers, etc.—which enter largely into the practical side of the problem. Enough has been said, however, to show that the flying machines of Langley's model are not built or launched in a hap-hazard fashion, but are the result of practical discoveries at the end of patient research.

As has been stated before, the air-ship part of the problem of aerial navigation is now a practical, although not a commercial, success. The flying-machine part of the problem is still in the beginning of its most elementary experimental stage, but inasmuch as models heavier than air have successfully navigated that medium, it is obviously only a question of time, of money, of patience and of brains, before this part of the problem also becomes practically successful.



The Langley Machine Ready to Launch



Wreck of the Langley Machine, October, 1903

Whether or not any type of air-ship will result from present investigations, which will be able to carry trade or to safely transport passengers, is purely a matter of speculation.

PHOTOGRAPHED THE PEAKS OF THE ALPS FROM A BALLOON.

A most sensational balloon ascent was made by Captain Spelterini of Zurich recently when he tried to cross the Alps and the towering peak of the Jungfrau in his enormous balloon "Vega."

The ascent was made from a specially-built platform at a station on the railway which ascends the Jungfrau. The big balloon which holds 56,500 cubic feet of gas rose successfully and passed over the mountain summits towards Adelboden. It first crossed the Jungfrau mountain towards Valais, then became enveloped in clouds and was thrown back towards Adelboden again where a landing was made. The Jungfrau is 13,671 feet above sea level, and the balloon ascended to an altitude of 20,000 feet. The trip was made for the purpose of securing photographs of the Alps and, as the weather was fine for several hours, this object was successfully attained.

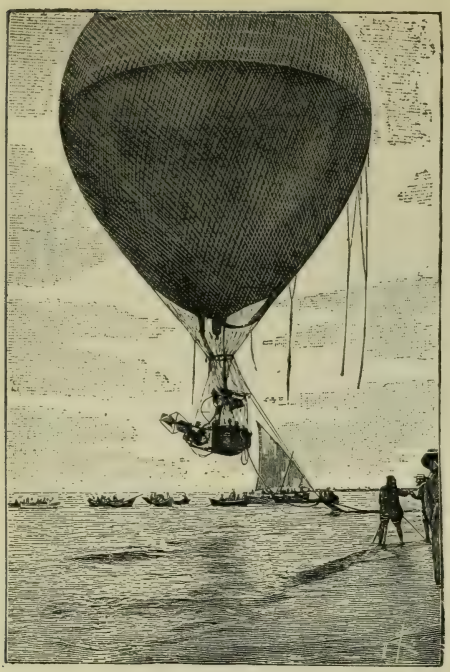
FRENCH AERIAL CRAFT HAS SOME STRANGE NEW FEATURES.

The "Mediterranean II." is the name of the immense balloon constructed by M. Herve, a Frenchman, who, for many years, has been experimenting with aerial craft. M. Herve began with the first principles of aerial navigation, proved them to his own satisfaction, examined, applied and reapplied them until today the Mediterranean II. represents the results of his years of study.

This balloon in point of equipment is most unique. It consists primarily of an enormous gas bag with dependent carriages for the aeronauts, but the amount of gearing and apparatus aside from these is astonishing. There are two wicker baskets, a very large one below and a smaller one above, and these are connected by strong taut rope ladders which lead on up to the gas bag so that at all times it may be reached by the occupants of the baskets.

One of the most unusual features of the balloon is its enormous aluminum propellers pitched at an angle determined after many severe tests and several disappointing failures. These propellers measure 23 feet from tip to tip, but only weigh 176 pounds, or, with the mast, transmission gearing and its brake, 232 pounds. They consist of two narrow blades placed one behind the other and joined in shutter fashion by small movable partitions. The propellers are geared to a powerful gas engine and, with the use of 18 horsepower, produce 397 pounds resistance at a fixed point. The propellers may be reversed.

But the feature of the greatest interest in the Mediterranean II. is the means by which, when passing above the sea, she is held steady and at any given height as she moves along. This is what is termed by M. Herve a pneumatic rudder and consists



The "Mediterranean II" Sailing Above the Sea

of a long drag of fabric connected with the gas bag of the balloon itself.

The balloon is an enormous affair. The pendent apparatus measures about 25 feet and this, surmounted by the huge gas bag 80 feet high, and trailing, either in the water or high in the air, the long snakelike drag, completes a conveyance unique in its line.

On the opposite page (1207) is shown the lower part of the "Mediterranean II" in the big shed where it is housed. A very good idea of the size of the big propellers can be had by comparing them with the height of the men standing on the ground.

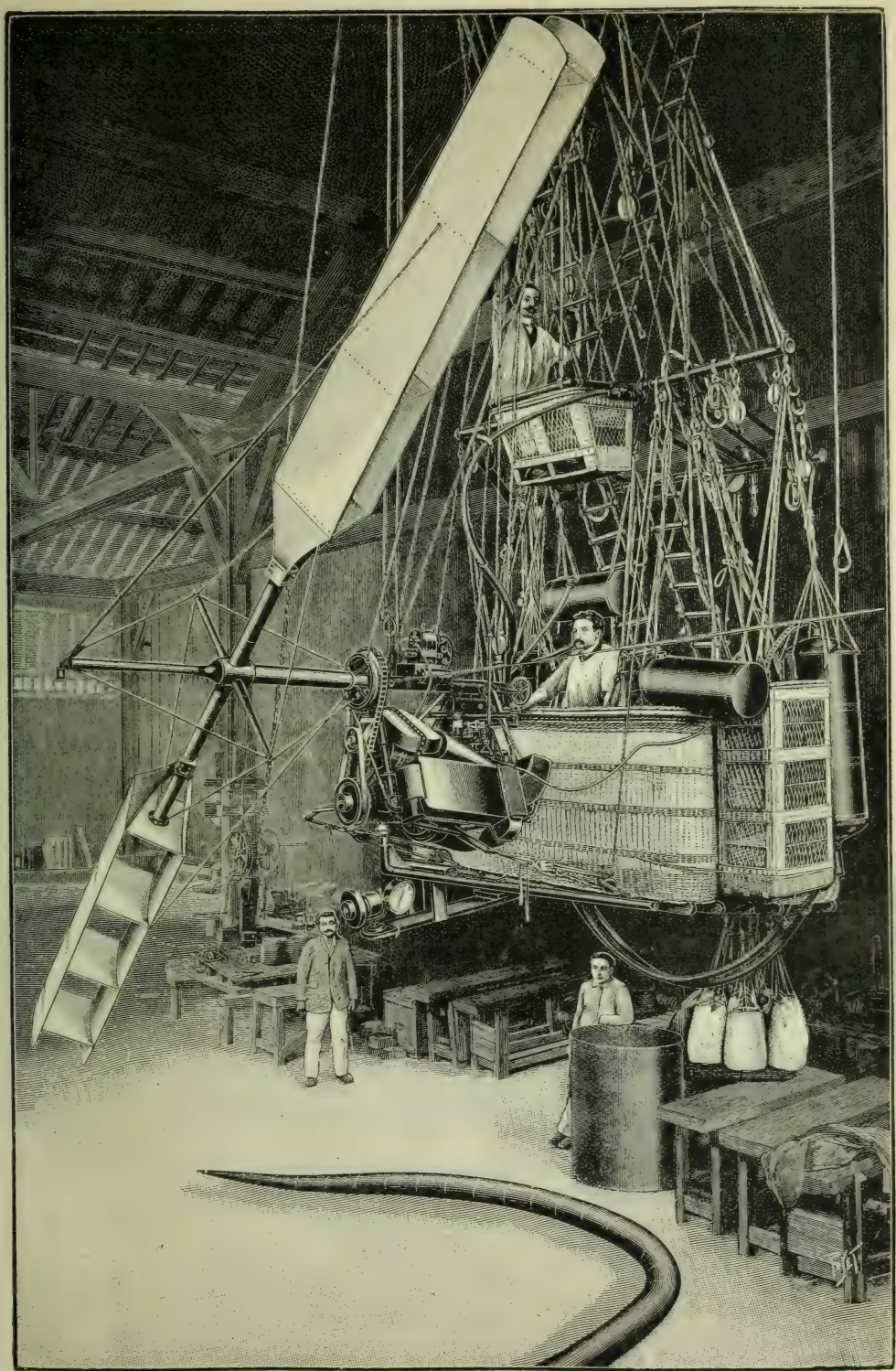
"I do not believe that, without such previous study and experience with a spherical balloon, a man can be capable of succeeding with an elongated dirigible balloon, whose handling is so much more delicate. Before attempting to direct an air-ship, it is necessary to have learned in an ordinary balloon the conditions of the atmospheric medium, to have become acquainted with the caprices of the wind, and to have gone thoroughly into the difficulties of the ballast problem from the triple point of view of starting, of equilibrium in the air, and of landing at the end of the trip."—Santos Dumont.

AIRSHIP CONTESTS AT ST. LOUIS.

The much heralded airship contests at the St. Louis World's Fair for a cash prize of $100,000 was unquestionably looked forward to by the public as the greatest feature of the Exposition. So much had been published during the past two years, and the accomplishments of Santos Dumont, in Paris, and the prospect of winning an independent fortune, combined to raise high hopes in the expectations of the people. If Dumont can sail an airship around the top of the Eiffel Tower, we naturally reasoned the Yankees were smart enough to cover the course prescribed by the Exposition officials. As a matter of fact, the required performance cannot be considered severe or unreasonable, for no air vehicle should expect to lay claim to being a practical success which could not earn the prize on the conditions imposed.

A great balloon house and park were constructed at a cost of many thousand dollars, and every facility provided for the expected contestants. In all parts of the country, local papers were telling about the wonderful airships which were ready, or almost completed, or to be built, and apparently the woods were full of inventors who had the prize as good as earned. But as the months went by less and less was heard, and it was only in the last fleeting weeks of the Fair that a few unsatisfactory attempts to fly a sky-chariot were made. The mystery surrounding the "accident" to Santos Dumont's craft, and his sudden return to Paris are still unexplained.

Baldwin's craft (described in October Popular Mechanics), the California Arrow, made several short, circling trips over and about the Fair Grounds, no one of which showed anything very remarkable. In its first trip it rose successfully under the direction of a Toledo aeronaut, A. Roy Knabenshuhe, and for a time answered its helm nicely, but before the test was over the motor broke, and though the aeronaut still guided the airship the result was anything but satisfactory, the ship being carried by the wind eastward. After drifting over the city, it crossed the Mississippi river and came down in a cornfield on the Illinois side. After another trip the airship broke loose while being carried back to the Grounds in the dark and was lost over night, some damage resulting. Its best flight was three and one-half miles, covered in twenty-eight minutes. In other flights it has traveled farther and stayed in the air longer, but the engine was not under control



The "Mediterranean II"—The Shed at Palavus.

all the time. After one flight the vessel landed within 100 feet of a designated point. Its highest speed made under control was but one-half the minimum speed fixed by the Exposition authorities in the rules governing the contests.

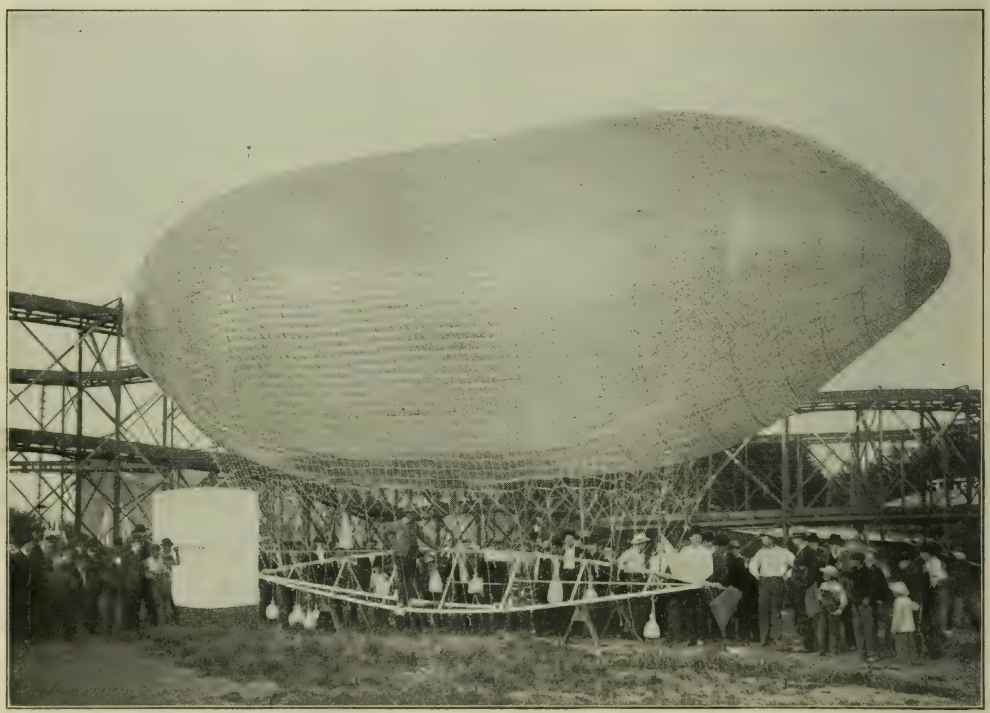
After several flights by the Baldwin airship it was announced that the great race would finally take place, and that several important entries had been made. Nothing further was heard about the contest by the outside world, however, and it now appears that after a rather spirited conference with the aeronautic officials Captain Baldwin has packed the "California Arrow" for shipment to California and has left the Fair Grounds himself.

Several ascensions of the old-fashioned gas balloons have been made from the Grounds, but were no different from what the public has been accustomed to see for years past, and the distance covered before the gas gave out was nothing unusual.

The airship races have proved a colossal fizzle, and while the public are disappointed, they cannot blame the management because the necessary contestants failed to materialize.

It is evident what we Americans don't know about navigating the air would constitute a large able-bodied fund of negative information. This should not be taken to be an admission that we cannot build and navigate airships, but simply that we have not done so. We can do anything inventors of any other country can do, and we ought to be able to accomplish a great deal more than they have, because their failures and experiences are ours, and our inventive ability should be better.

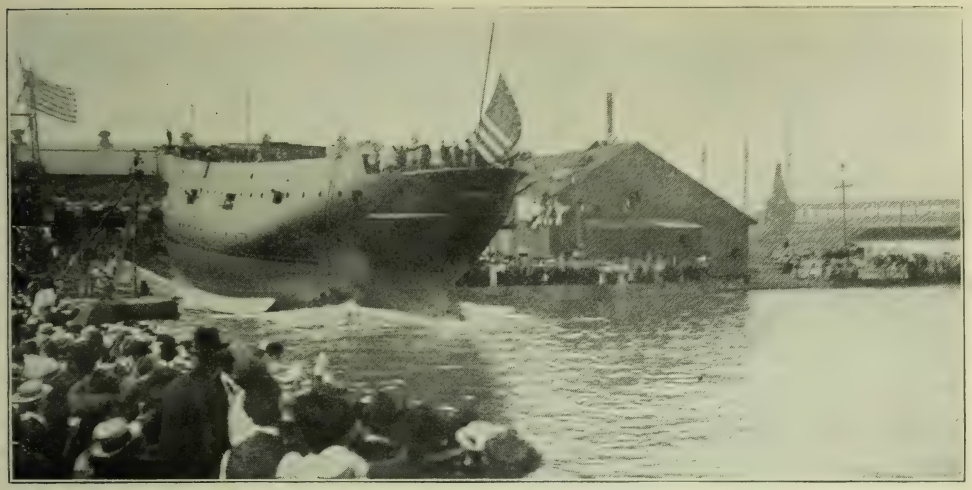
At present writing the situation of this country in the aerial world is simply that of being "not in it," and Santos-Dumont, a Brazilian resident of Paris, has us beat good and proper.



The Baldwin Air-Ship at the St. Louis Exposition

An airship race from Chicago to New York, or San Francisco to New Orleans, with a dozen entries, and at least half of them covering the entire distance without "going on shore," would be something worth while. But the St. Louis contest!—well, it's nothing of which to be proud.

The "Cumberland"—New Training Ship for American Jackies



Launching the "Cumberland" at the Boston Navy Yard

One of the new additions to the United States navy is the "Cumberland," recently launched at the government navy yards at Boston, Mass. This vessel, which is a steel sailing ship with a length over all of 210 feet 6 inches, draught of 16 feet 5 inches, and a displacement of 1,800 tons, will be used strictly as a training ship to teach young "jackies" how to sail a ship and shoot a gun. The only machinery on board are four engines for auxiliary purposes, such as hoisting, lighting and water condensing.

Accommodations have been provided for 16 commissioned and warrant officers and 320 enlisted men.

The battery consists of six 4-inch rapid-fire guns, four 6-pounders, two 1-pounders, and two Colt automatic guns, calibre 30. The cost will be about $370,000.

The "Overland" Mail in Thibet

How the Mail Bags of the British Mission to Thibet Are Carried Back to India

The bags are carried on rude ekka carts drawn by yaks. A British soldier is in command of the native attendants accompanying the carts.

Bridge Building in the Philippines

The construction of bridges in the Philippines is attended with a good many difficulties, not the least being that the tall trees of from three to five feet in diameter which are used nearly always have bees' nests in their tops and running when the trees fall does not save the men from stings.

Moreover, the engineers and native workmen must be attended by soldiers to protect them from attacks by Moro warriors.

The trees are felled with tiny axes and then there is neither saw mill or power plant to cut the timber; the work is done with hatchets and axes. The huge, tough roots of the trees are used for pinning the logs together, big bridges often being built without even an iron spike in the whole structure. The bridges are immense pyramids of heavy hardwood logs, with a rock filling for weight. Great timbers are laid across the supports and these are covered with a flooring of lumber. The bridge must be heavy to hold against swift currents.

Building a Bridge in the Philippines

ROAD LOCOMOTIVES

Road locomotive is the name which is now properly applied to the monster machines which are the outgrowth of the little traction engine of a few years ago. The size, weight and power of the road locomotive has increased with the rapidly increasing uses to which it is now applied.

The illustration on the front cover shows one of the latest types of road locomotives; a machine 25 feet in length, 10 feet wide and measuring 13 feet in height. The rear wheels are 96 inches diameter, 30-inch face; front wheels 54 inches, 14-inch face. The fire box is 58 by 35 by 45 inches; 93 boiler tubes, 2 inches diameter, 108 inches long; the grate area is 15 square feet, and the entire heating surface is 508 square feet. The boiler pressure is 160 pounds; engine speed, 200 revolutions per minute. The tender is of steel and will carry 520 gallons of water, sufficient for three hours, and 1,200 pounds of coal, which will run five hours on ordinary roads. The locomotive has a speed ranging from 2.64 miles to 5.69 miles per hour; the speed being regulated through gearing.

This machine is capable of drawing from 40 to 50 tons up grades from 5 to 10 per cent. The levers are all placed on one side for easy control from the engineer's seat.

When the good roads movement has secured really good roads throughout the country, the movement of farm produce in wagon trains drawn by road locomotives will be a common sight, and will enable the farmer to choose his line for shipment of freight without regard to his nearest railroad station.

POPULAR MECHANICS INDEX 1904.

A complete index to articles which have appeared in this magazine during 1904 is now ready and will be mailed free on request to all who desire to bind their volume.

BOUND VOLUMES OF POPULAR MECHANICS.

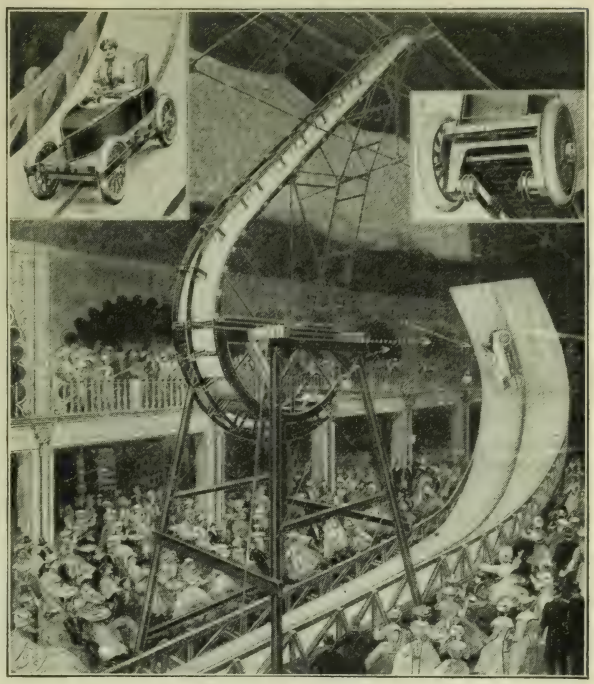
A limited number of bound volumes of Popular Mechanics, with index, for 1904 can be purchased of the publishers. The books are substantially bound with leather back. Price $3, express charges prepaid.

Meteor Auto, a French Amusement

A French pleasure resort has installed the most thrilling loop-the-loop device of any yet in operation. The apparatus is not so far open to the use of the public, which is continually demanding madder sensations, but, strangely enough, a woman, Madame Mauricia de Tiers, takes the seemingly perilous flight night after night, and the sight comes near affording sensation enough for even the most daring. The apparatus would, of course, perform the same wonderful feat without an occupant for the little carriage which makes the journey, but the insatiable public demands that a human being shall take the ride with all its risks, though the occupant in nowise controls the vehicle.

At the beginning of the daring feat Madame de Tiers seats herself in the little carriage, which weighs about 882 pounds and is shaped much like an ordinary automobile. It is 3 feet 3 inches wide and 5 feet 2 inches long. The under side of this vehicle is provided with rollers, as shown in the cut, which hold the car on the rails of the track on which it travels. The start is made on a 45-degree incline, which, at a height of 42½ feet above the ground, terminates in an arc of a circle, around which the vehicle dashes at a rate of nearly 40 miles an hour, and with a slight backward motion is carried by its momentum out across 33 feet of space, with wheels revolving, and is thus turned completely over and strikes a second incline, where the vehicle continues its course until terra firma is again reached. Fig. 1 shows the occupant on this second declivity as she always appears after the mad ride, smiling, serene, seemingly wholly unaffected by the perils through which she has just passed. The large view is from an instantaneous photograph made for La Nature.

The steering wheel on the auto does not guide the vehicle's movements, but is only for effect.

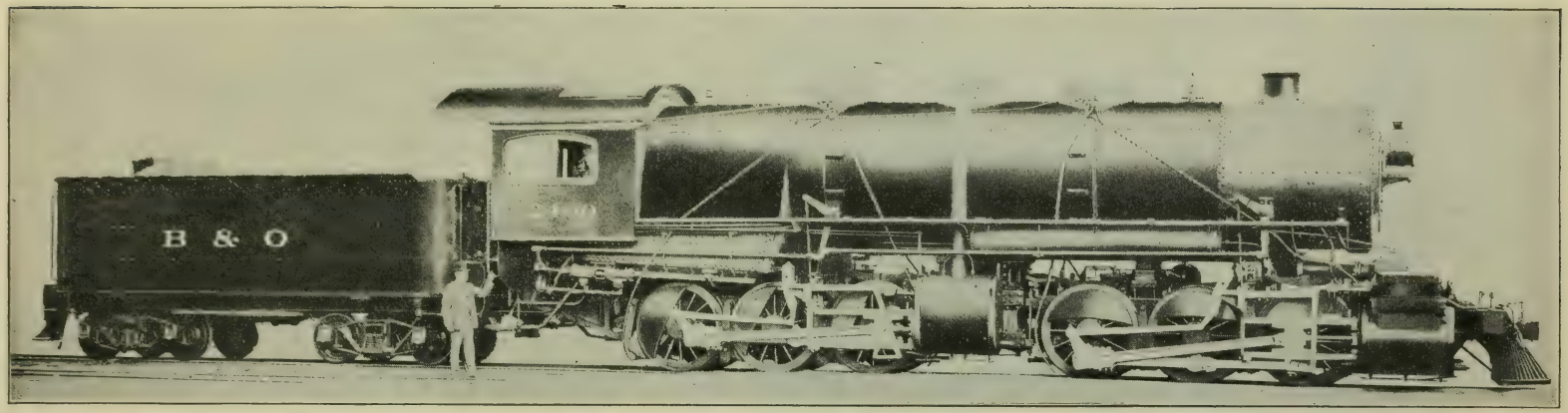


The Meteor Auto--A French Loop-the-Loop and Leap-the-Gap Device

PORTABLE FLOATING DOCK FOR BALTIC FLEET.

A floating workshop is considered indispensable to the operations of a modern battle fleet, but Admiral Rozhdestvensky has improved on this, and expects to be able to take a dock with the Baltic fleet out to the Far East. The admiral has given orders for a floating dock consisting of small sections to be built at Odessa with the utmost dispatch. There are to be eighty separate sections, which can be connected up so as to form a dock of different lifting capacities, with a depth over the keel blocks of from 26 feet to 27 feet. This would enable the dock to lift the cruisers of the squadron, although it would not admit some of the battleships which have mean draughts of from 26 feet to 29 feet. But as the dock is being built at Odessa, it is evidently intended to send it away by the cruiser detachment, which will go east by the Suez Canal.

Heaviest And Most Powerful Locomotive Ever Built



The heaviest and most powerful locomotive ever built has been on exhibit at the St. Louis World's Fair, and once again we describe "the largest locomotive in the world." It was constructed by the American Locomotive Company for the Baltimore and Ohio railroad and after the Fair will be used as a freight locomotive on that line.

The locomotive is of the Mallet articulated compound type, which is especially adapted for use on roads having heavy grades and sharp curves, as it permits compounding under the most advantageous conditions, as the high pressure cylinders can be applied to one truck and the low pressure cylinders to the other and any desired ratio can be adopted. The work is thus divided between the two sides of the engine and the retardation of cut-off gives a nearly uniform turning moment. The engine can be operated on curves of 20 degrees and upwards with great ease and less frictional resistance than an ordinary consolidation engine of half its capacity.

Each pair of cylinders is connected with three pairs of driving wheels, the rear high pressure group being rigidly attached to the boiler, while the forward or low pressure group is on a swiveling frame, the motion of which about its center is duly restrained by springs which also tend to bring the forward group of wheels into proper alignment when the engine enters a tangent. The wheel base of each group of three pairs of driving wheels is 10 feet, and total wheel base of the engine is 30 feet 8 inches. The total weight of the engine in working order is 334,500 pounds, or slightly over 10,900 pounds per running foot of wheel base. The normal tractive power when running compound is about 70,000 pounds, but this can be increased (by working the engine simple) to 85,000 pounds.

The outside diameter of the driving wheels is 56 inches. The boiler is of the straight top, radial stay type 84 inches in diameter at the front end with a working pressure of 235 pounds per square inch and a total heating surface of 5,585.7 square feet. The tender, which weighs 143,000 pounds, has capacity for 7,000 gallons of water and 13 tons of coal.

The engine measures 79 feet 6½ inches length over all; 10 feet 5 inches in width.

Sunken Treasure of Old Spanish Galleons to be Raised by Compressed Air

The sunken treasure ships of Spain are at last to yield their secrets and their treasure to the wondering eyes of men. For a period of 200 years they have rested under 90 feet of water on the bed of the Bay of Vigo, half buried by shifting clouds of sand poured upon them by two rivers which flow into the bay. The ships are supposed to contain $140,000,000 of treasure, but all efforts by divers to recover it hitherto have been fruitless because of the sand which prevented them seeing anything at that depth.

Cavaliere Pino, a Spaniard, as his name

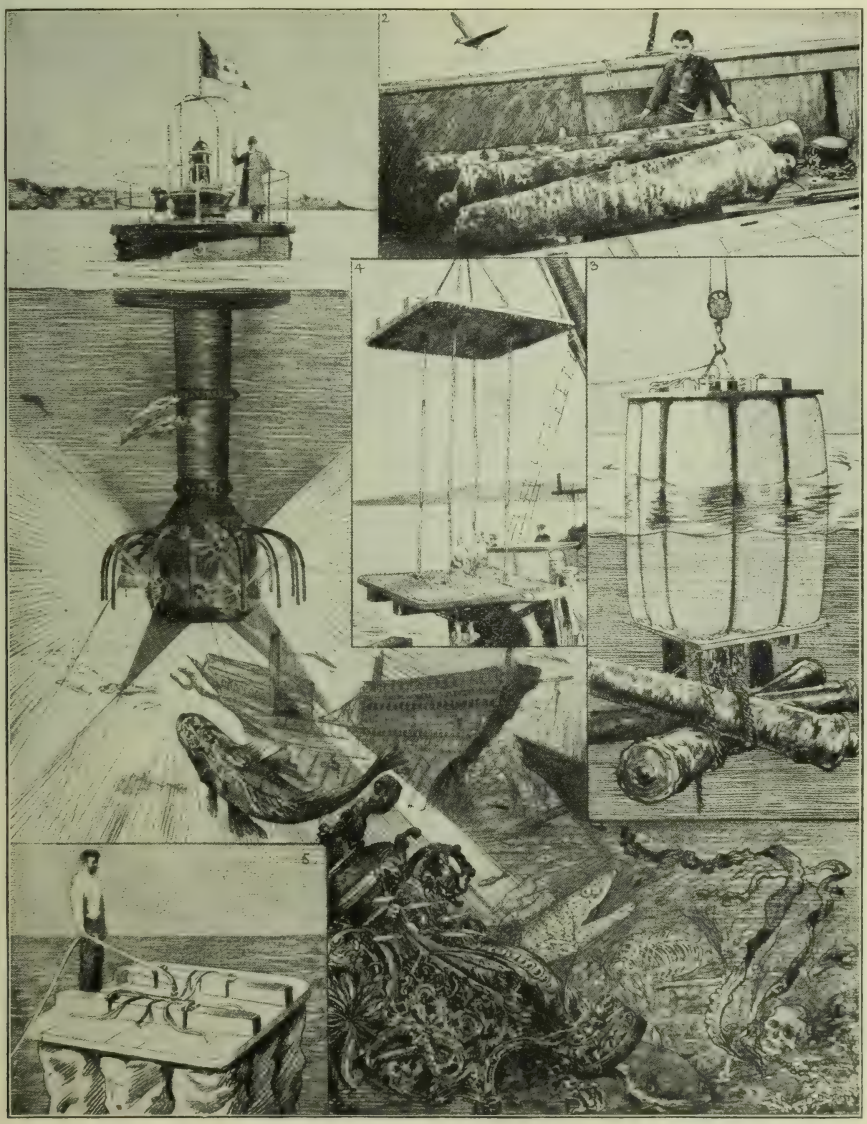


Fig 1—Water Telescope.
Fig. 2—Guns Raised by Apparatus.
Fig. 3—Compressed Air Elevator.
Fig. 4—Framework of Elevator.
Fig. 5—Inflating the Bags.

indicates, has invented an apparatus by which the recovering of the sunken treasure is now assured. It consists of a water-telescope, the like of which was never before used for wreck-raising purposes. From a steel platform buoyed up by a mass of cork depends a strong steel tube large enough for a man to descend its full length on the steps within. The bottom of the tube is open and through it plays a strong current of compressed air to keep out the water. At the lower end of the tube is a huge camera having 12 powerful lenses which were specially constructed by Saint Goubin of Paris, and through which the man within the tube can view the wreckage to his heart's content and the tube can be slowly moved so that he can handle and examine any particular object (Fig. 1).

The tube, which is now in the course of construction, will be telescopic and capable of being elongated to meet the requirements of depth. It will be built in watertight compartments, lit by electric lamps and communication with the surface will be by telephone.

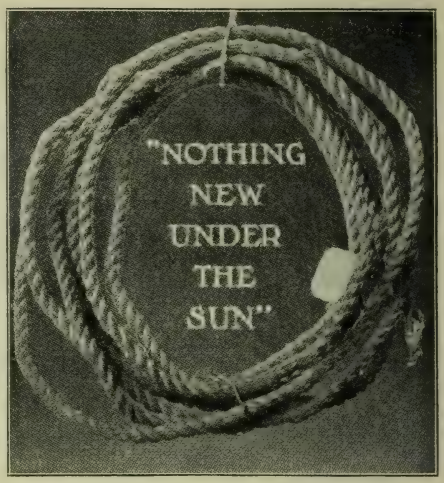
The Spaniard's method of raising wreckage is quite as unique and ingenious as his hydroscope. In Fig. 4 is shown the framework on which large flexible bags are arranged and connected to the special platforms of the framework. In operation this apparatus is attached to the object or objects to be raised and compressed air is pumped into the bags until the air pressure overcomes the resistance of the water and of the object and the compressed air elevator rises to the surface with its load, as in Fig. 3, where it is bringing up old guns. The guns so raised are shown at Fig. 2, and at Fig. 5 is shown the method of inflating the bags.

UNITED STATES BATTLESHIPS NOW UNDER CONSTRUCTION

The two battleships "Connecticut" and "Louisiana" recently launched, each of 16,000 tons displacement, will be among the most powerful battleships in the world. Besides these the government now has under construction eight large armored cruisers, two of 14,500 tons, three of 14,000 tons, and three of 13,600 tons and eight other battleships, three of 15,000 tons, two of 14,600 tons, two of 13,000 tons and one of 12,500 tons. If all these are in commission by 1908 we will have 24 battleships and 10 armored cruisers in our navy.

WIRE ROPE MADE BY THE ROMANS 1,800 YEARS AGO.

Nearly 2,000 years ago the Romans knew how to manufacture wire rope which closely resembled the wire rope in use at the present day. This astonishing fact was brought to light by the recent discovery of a coil of wire rope in the ruins of Pompeii. The rope is about 15 feet long and 1 inch in circumference. It is made of bronze wire



Coil of Wire Rope, 1,825 Years Old

and consists of three strands of spirally connected wire, each strand being made of 15 wires twisted together. A most interesting fact is that the rope is stranded in accordance with lang lay, which is in general use today.

It is believed that the rope was used as a crane rope, for pieces of cranes were found also. These cranes, it is generally believed, were worked by slaves who were placed inside a large drum, which was turned in a tread-mill fashion and thus worked the small drum around which the rope was found.

Pompeii was buried in A. D. 79, about 1,825 years ago. The coil of rope is now in the Musio Barbonico at Naples.

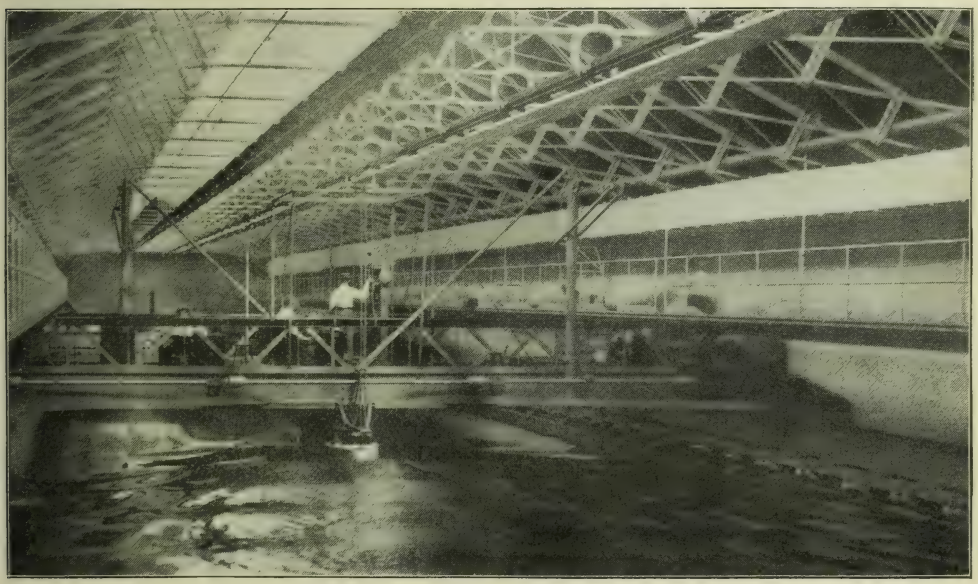
At an expense of $30,000 the Pullman Company will establish laundries, where at the end of a run all its employes may have their clothes cleaned at the expense of the company. Each of thousands of employes will be given three complete uniforms.

Forecasting Ship Speed and Action

How the Government Determines Precisely What a Great Battleship Will Do Before Even the Keel is Laid

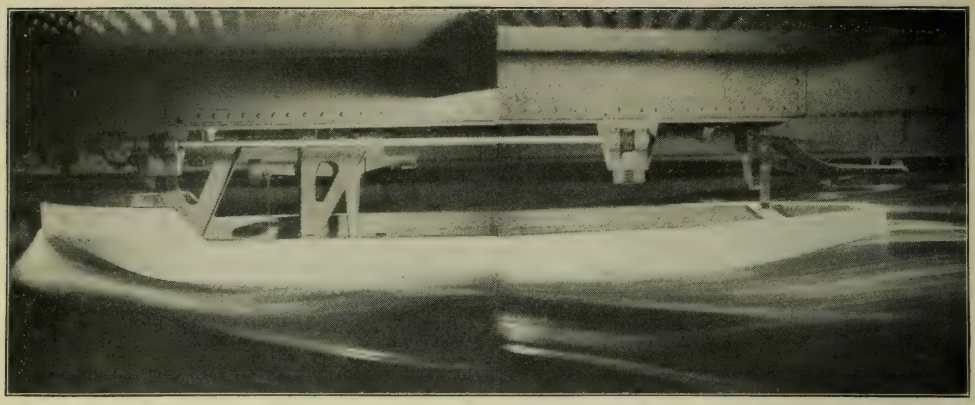
There is at the Washington Navy Yard a peculiar and interesting factory, the like of which is not found elsewhere in this country. It is a boat building factory, but the boats are not used for carrying people or things, nor are they toys. They are warships in miniature, the unequipped hulls, known as ship-models. When the government desires a new warship, and Congress makes the necessary appropriation for it, the Construction Department of the Navy makes the detailed plans in drawings giving every portion of the proposed vessel. This is done for two purposes—for furnishing working plans for contractors or government employed workmen, and for guides in making a model of the ship. The Department desires to know as far as possible what the speed and action of the designed ship will be at sea; and to find this a model of the vessel is constructed, run through the water of the testing tank and its actions noted. These trials may prove satisfactory at first tests, but if not so the model's lines are changed until better results are secured.

The model making factory is a large building situated near the model testing tank, close to the Potomac River, and contains a number of electric motors that do all the power work, except in one particular, the use of hydraulic pressure for putting together wooden blocks—"blocks of shape"—from which an initial model is made. These blocks are worked down to conform to the drawn ship plans, until an approximate hull-frame is obtained; over this, small half-round strips, making a corrugated appearance, are placed, and then plaster of Paris is put on and manipulated until the surface lines laid down in the plans are obtained.



Testing Tank With Model Going at Four Knots an Hour, or One-Fourth Ship Speed

After the bottom of the initial model is smoothed down it is taken to a reciprocating lathe, a machine about 40 feet long, operated by means of eight 5-horsepower



Side View of Model "Under Full Steam"

electric motors, and consisting principally of saws, planes and a guiding arm mounted on sliding carriages. While the first model is being made, a second, the real representation of the big ship, is in part constructed; thick strips of planking about three inches wide are glued together forming a rough shape of the true model needed. The initial model is now placed on the lower platform of the reciprocating machine and the true model placed above where it can be engaged by the shaping tools. When the machinery is set in motion the guiding arm, having at its end a concave metal block, follows the shape of the under model, and reciprocating saws cut to depths representing the latter's shape in the upper one. The model is now automatically planed down to the saw-cut shape, and is then worked over from measurements with hand tools until all the lines of the drawn plans are justified.

Now the embryo ship is painted, weighed, furnished with mechanical attachments and taken to the model testing tank to prove its fitness for the work desired. The tank is in a brick building 500 feet long by about 50 feet wide. On both sides of this there is a railed track, extending nearly the whole length of the structure, upon which runs a towing-carriage; this spans the tank and is operated by means of direct-connected motors, each of 50-horsepower, one being carried on each of the four carriage trucks. The power required is obtained from a separate electric plant in the Navy Yard, which also runs the model making shop.

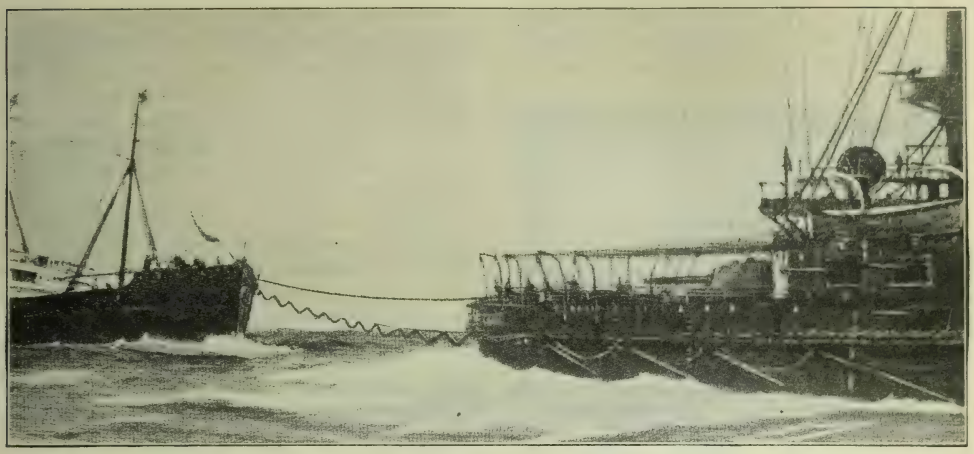
The model, usually about 20 feet in length, is put into the water directly beneath the towing carriage, to which it is movably attached by metal arms arranged at bow and stern. The model is also electrically connected with the carriage, which carries chronographic apparatus for measuring speed and force expended; also recording action of the miniature ship of war.

Models are tested at various speeds and these differ according to ship lines and amount of resistance against the water. The speed runs as high as six knots, corresponding to 27 knots for the ship at sea; but the average is about four knots, about one-fourth of the speed of the ship. The carriage runs very smoothly and can be speeded if necessary at the rate of 20 knots per hour.

The value of the information obtained by the Government from model testing more than offsets the considerable expense thus incurred. By this work the Navy Department not only secures an excellent idea of the capabilities of the proposed new ship, but it can use this data to advantage in making contracts with ship builders in the particular of required speed, etc. And with the builder there is no guess work; with the ship plans drawn to the smallest detail, and, if necessary, corrected from model tests, he follows instructions, and is carefully followed in his operations by the Government's expert who keeps track of every particular of the work.

The only woman "sword fisher" known, is Mrs. Jno. Latham, of Noank, Conn., where she and her husband reside during the winter months. She saved the life of her husband recently when attacked by a monster sword fish. The Lathams have a sloop which is used for sword fishing only.

Liquid Fuel Pumped to Battleship While in Motion



Pumping Oil to a Battleship While in Motion

The English navy has been experimenting with oiling battleships while they are still maintaining their maximum speed. The tests were very satisfactory, indeed.

The battleship took the oil vessel in tow with a 6½-inch wire hawser. From a lighter wire was suspended 200 yards of 6-inch wire hose fastened to the wire every six feet. The hose was fixed to the net shelf and then taken to the connection on the ship's side. The battleships "Hannibal" and "Mars," with which the experiment was tried, each carry 190 tons of liquid fuel, and this amount was pumped in six hours, the speed of the vessel being retarded but one knot. Another great advantage of this arrangement is that it can be used in any and all kinds of weather.

The German fleet is resorting to oil in increasing degree for firing purposes, it is stated. All German battleships burn both oil and coal, and several oil-tank vessels have been ordered constructed for the use of the fleet, as their use is said to greatly facilitate filling the war vessels' oil tanks, and to be more cleanly than coal bunkers.

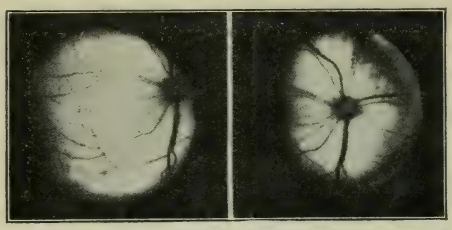
$10,000 FOR WINNER OF OCEAN RACE.

There is soon to be a race across the Atlantic between motor launches, and the winner (if he succeeds in getting across alive) will receive a prize of $10,000 which has been offered by M. Charley, a rich French sportsman. The contesting launches will be 65 feet or less in length and driven by gasoline engines. The Shipping World, London, says:

"M. Charley, in response to a wager from America, will himself compete with a 65-foot boat. It is interesting to note that Mr. Edge is experiencing in his 65-foot cruiser the same trouble as has been met in using turbines for naval propulsion. Like the turbine, the internal combustion engine must be driven at full power to work satisfactorily. The consequence is that Mr. Edge's boat will have three shafts and three engines. The two outside shafts will each be provided with a 150 horsepower engine, and the center one will be driven by a 40 horsepower oil engine. The idea is that only the small engine should be used for slow speeds or going alongside, whilst for full speed the two larger engines would be used, and for an extra fast burst all three would be in operation. It seems rather a tall order to start off across the Atlantic in a 65-foot motor boat; of course the boats which have entered are not the racing freaks which came across the Channel a short time ago; but I should at any rate like to feel sure that, in the event of the engine stopping, the boat could be kept going along with a mast and sail."

INSTRUMENT PHOTOGRAPHS THE INTERIOR OF THE HUMAN EYE.

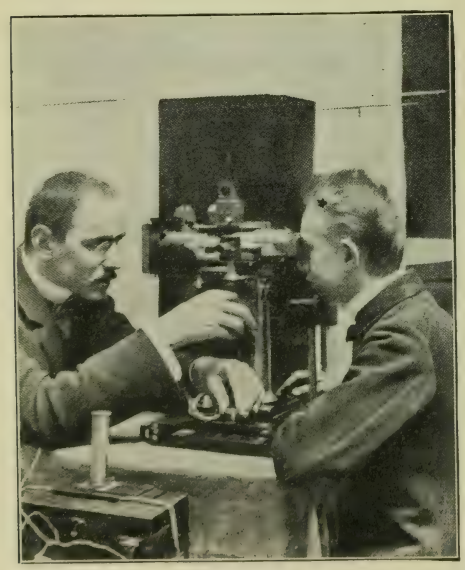
Treatment of diseases of the human eye will be greatly facilitated by an instrument lately invented by Dr. Walther Thorner of the University Eye Clinic at the Royal



A Photograph Made With the New Instrument

Charité, in Berlin, by means of which good photographs may be secured of the interior of the human eye. Hitherto this had been impossible because of the difficulty in sufficiently illuminating the interior of the eye, the strong light and the duration of the exposure not being endurable by the patient. All observations of this part of the eye were made by looking at it through the ophthalmoscope, invented by Helmholtz in 1850.

The new instrument is a material improvement of the ophthalmoscope. It was first used in photographing the eyes of cats and then improved and reinforced until adapted to the much darker interior of the human eye. By employing a soft light the eye is first focussed so that its back is clearly imaged on a photographic plate. With the plate in, pressure on a special lever opens the camera and an electric spark generated in a storage battery ignites a flash-light composition, thus lighting up the background of the eye so that a good image is produced on the plate.



Photographing the Background of the Eye

The new instrument means that diseases encroaching upon the eye may be watched in each stage, that the progress of the disease and the success or non-success of the treatment will be apparent at any and all times, and that physical differences in eyes will be plainly put before the oculist, who will thus be enabled to profit mankind by his observations. Any separate part of the interior of the eye may be photographed by the new apparatus.

AMERICAN-BUILT SUBMARINE BOATS FOR JAPAN.

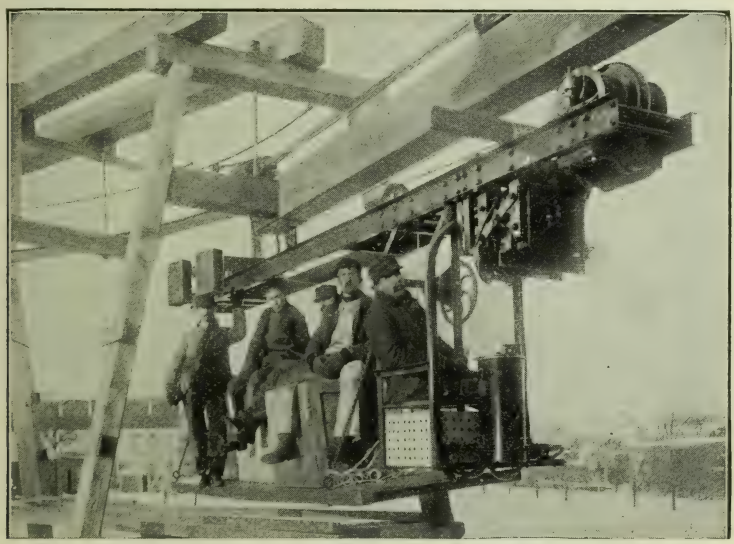
Five submarine boats, superior to those owned by any other nation, are now being built in this country for the government of Japan, though nominally, for the sake of neutrality, they are being built for the Holland Submarine Boat company.

The boats are 58 feet 9 inches from stem to stern, with an extreme width of 11 feet, and have a guaranteed speed of from eight to ten knots. They have a number of features which make them decidedly superior to any others of these craft now in existence. They are built of the best steel, reinforced amidships by 10-foot strips of Tobin bronze plates half an inch thick, making them far less vulnerable if sighted by the enemy when on the surface. They are equipped with bilge keels, which makes it possible for them to make long voyages and to accompany a fleet to sea without a tow. The "Moccasin" and the "Adder," the two finest submarine boats in the United States navy have a maximum speed of six knots; the new boats for Japan not only have a higher speed, but can maintain it at a depth of 120 feet. Few submarines formerly constructed often dive deeper than 40 feet. The greater speed involves a secret method of using both electricity and gasoline for motor powers, while diving rudders of secret design secure the greater powers of submersion.

Aerial Transportation

How the Telpherage System Economizes for the Manufacturer--Some Startling Facts and Figures

The word telpherage, which is derived from two Greek words meaning far and to carry, has assumed a meaning not included in those two words since it has become a great, though not widely recognized factor in industrial economics. No other word comes nearer being synonymous with economy than does the word telpherage. It means economy of time, economy of labor, economy of money. And yet, embracing all these advantages—considerations the American manufacturer is eternally striving for—this wonderfully effective electrical agent is little appreciated by those it is calculated to most benefit.



This load, with the five men, lifted 50 feet and conveyed 1,000 feet, showing massiveness of construction of the conveying and hoisting machinery, method of electrical control and brake wheel.

Perhaps the greatest claim that can be made for telpherage is that while yet embracing these three great economies, it is perfectly flexible, can be adapted to the most discouraging conditions without diminution of its efficiency. If the route of the telpher way is rough, and many obstructions have been encountered in its construction this does not affect traffic on the aerial line when once it is installed. With its use the bags, boxes, bales, or barrels which once consumed an amount of time, money and labor, disproportionate to the rapid operation of the rest of the modernly equipped factory, is reduced to its proper ratio and fits into the system as nicely as the cogs of one wheel engage those of another. Over a distance of 1,000 feet of telpher way, a single telpherman with one machine and an assistant can convey 250 tons per day and should the system be out of commission for even an hour, the plant during that time is a non-consumer except in interest charges.

Telpherage is best adapted to the action of the direct current as it is included in the "intermittent control" type of electric propulsion.

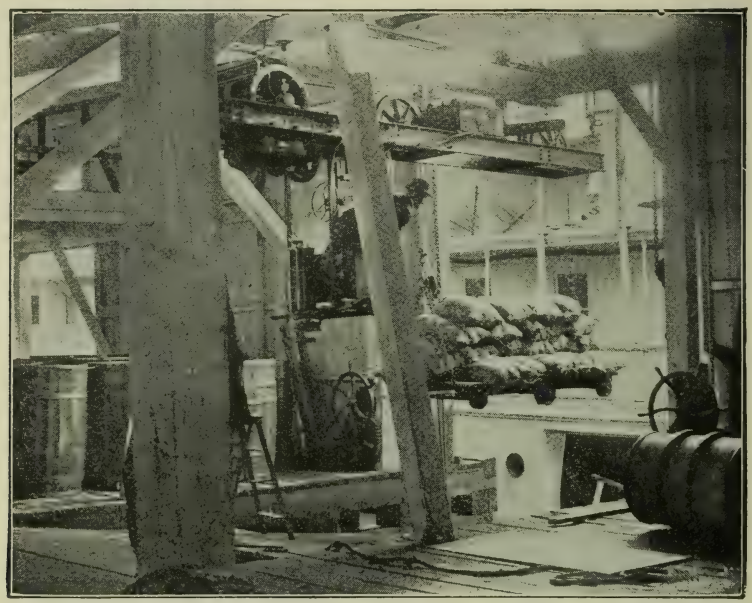
The telpher line consists of tracks of solid steel or steel cable built, usually, 20 feet or more above the ground. Where cables are used they are supported every 100 feet by means of poles or structures, if it is convenient to erect them, and with a solid track the supports are placed at from 16 to 20 feet apart. A telpherage plant usually consists of one or more telphers with or without trailers, but generally in combination with an electric hoist for lifting and depositing the load; a single or double trolley wire above the track for

conducting power to the telpher and hoist; one or more buckets or carriers for each telpher and the controlling switches, conveniently located. The material to be carried is suspended underneath the track and the carrier may be a large cage of any kind, or a truck with wheels for rolling it around on the floor. In long spans over river gullies, canals, railway tracks, etc., steel cable is invariably used instead of the steel track. When this is the case C-shaped wrought-iron hangers, having an upper grasp on a stout suspension cable and a lower clutch on a 3-foot beveled shield into which the running cable is sunk, support the running cable between posts. This tightens the suspension cable so that excessive sagging of the running cable under a load is prevented and also maintains the latter at a slight elevation so that the track is level when the telpher crosses the shields.

This suspension is used in all cable installations and over rivers oft-times triple or quadruple suspensions are required and high structural steel towers at either shore provide the necessary suspension dip. The tracks inside buildings are solid steel, supported every 15 to 25 feet, and the trolley wire, which is above the tracks on the outside, is inclosed in a conduit to guard against fire and runs alongside the track on the inside.

The telpher is, in other terms, an electric locomotive of the very simplest construction. If the load is of such nature that all its weight is pendant from one point as in conveying coal, a follow wheel is attached to the telpher frame and for distributed loads a two-wheel trailer is attached by a connecting rod. The trailer is always used where a telpherman travels with the load.

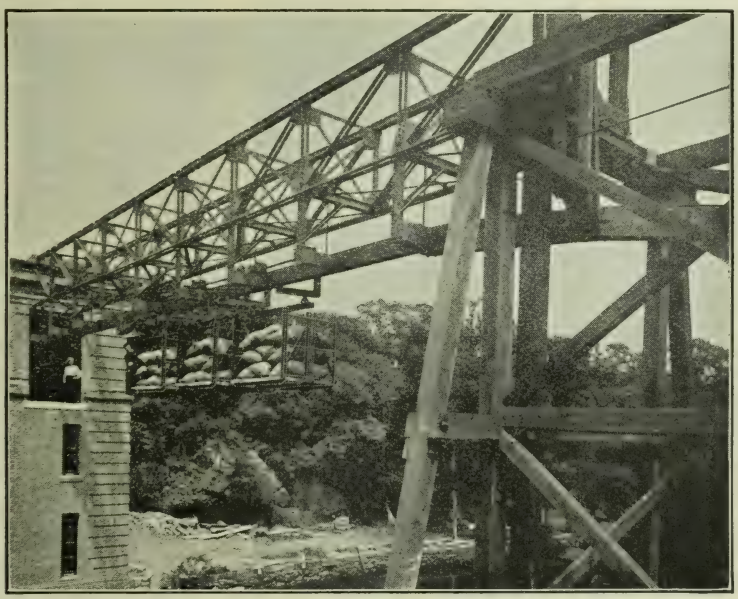
The hoist is suspended below the telpher, or sometimes from a trailer drawn by the telpher. Special attention has been paid in the later designs of hoists to use as little headroom as possible. Formerly the telpher and hoist were combined, but experience has shown that it is better to make the telpher and hoist two separate pieces of apparatus. It is composed of a double gear, a worm and drum, and comes very near being a direct-connected appliance when in position on the telpher.



Taking freight from or lowering to the side ports of a steamboat. In unloading, the material is raised and then conveyed any reasonable distance. Load, 6.000 pounds; speed of hoisting, 60 feet; speed of travel, 1,000 feet per minute. Independent of fall of tide. Track can be extended so as to take load directly to or from barges or floats. In one telpherage installation one man replaces sixteen.

There are three types of telpherage—automatic, semi-automatic and non-automatic. In automatic control of telpherage it is possible for the operator to start the machine by means of its controller located at some fixed point and it will whizz along its track to the other end, automatically deposit its load, reverse its direction and return for another load. This is accomplished by the use of an electrically-operated switch working in conjunction with the controller. In ordinary electric railway practice four wires are required in reversing each motor, but only two trolley wires are used in the entire operation described above. In the method of hoist operation each machine is supplied with a small cylinder switch which a solenoid, working against a spring, manipulates. In lifting a load power is infused through a stationary switch located at any point on the line, thus energizing the solenoid of the automatic switch and putting a tension on the spring. The solenoid is then de-energized, and the released spring rotates a cylinder which changes the various connections and so reverses the motor. The operator can cut off the power at any point in the hoisting and so stop the load, for all breaking of the current is done at the stationary controller and never at the cylinder switch on the hoist. The motor would be reversed by the cut-off, of course, but all that is necessary, should the operator wish the load to go higher, is simply to turn on the power again and again cut off, and when the power is again turned on the elevating is resumed. This method is also used in operating the telpher and in the control of semi-automatic telpherage.

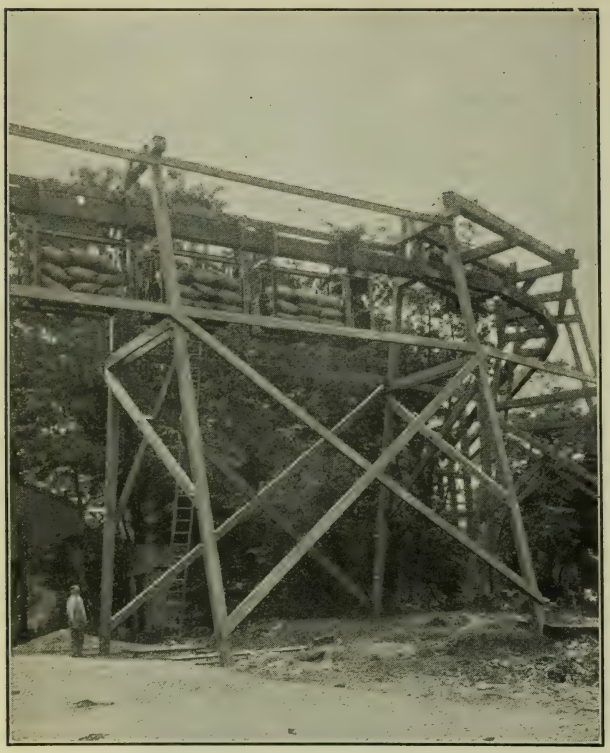
The semi-automatic line may be controlled by a man in a small house on the trestle, who, when the bucket is filled, throws on his hoist switch, and when the load is at the height desired opens the telpher switch and the machine runs down the line. Sometimes such lines are automatic after the hoisting is accomplished, the telpher being started by the hoist clutch contact opening the switch, after which the automatic working is as previously described. The operator can stop the load at any point, and if an automatic device for dumping is supplied the load is dumped there.



The telpher crosses the river, 50 feet above it, on a steel bridge, and enters the mill at the third floor.

Of the three types of telpherage, however, the non-automatic, where the telpherman travels with his load, controlling every movement of the machine is much more commonly employed. In such case the telpherman may be his own loader, unloader, hoister, conveyor and depositor at one or many points along a line, and can

keep intelligent account of his receipts and deliveries. Mr. C. J. Messer of the United Telpherage Company, describes such a telpherage installation in New England, where cases of goods are carried between two buildings 1,200 feet apart. A pendant attachment permits the telpherman to lower himself 40 feet inside the building. Trap doors in floors permit his loading or unloading at any particular floor. If out of doors he loads and unloads from projecting platforms at each floor of the building. This transportation formerly kept three teams, and two men with each team employed. The cases were conveyed from the ground floor to the place required by elevator, each round trip requiring 20 minutes. The telpherman's trip takes but one minute.



The telpher with its load rounding a difficult curve.

In regular service the speed of the telpher varies from 300 to 800 feet per minute up to 20 miles per hour, or even more, when required. The slower speeds are used when the lines are short and where there are many curves, particularly for factory and foundry work. Grades are easily surmounted, the highest grade met in actual practice thus far being a 12 per cent rise. To carry half a ton on a level track at a speed of six miles per hour, much less than a horsepower of energy, including all losses, the actual figures being one-sixth horsepower, is required. This amount increases considerably with grades, and on very steep grades gears are used to avoid employing very heavy motors. The number of telphers used may be increased indefinitely up to the full number the tracks will hold.

At Milton, Mass., there was recently installed a telpherage line a sixth of a mile long for conveying material from a railway storehouse to a mill. Before the telpher line was in operation all the raw stock had been trucked by teams to the works over a long, circuitous route and was then carried by elevators to an upper floor of the mill. This involved a great deal of labor as well as a large number of teams and much time. The new telpherage plant takes the loads directly from the top floor of the railway storehouse and conveys them by the shortest possible route to the third floor of the mill.

The construction of this line involved some very difficult engineering. The only piece of level ground on the whole route was 60 feet beyond the storehouse. The track then turns a 90° curve of 40-foot radius and passes along the side of a rocky, precipitous cliff at the foot of which is a swift running river. On the rocky ledge of the river bank it turns another 90° curve, this one of 20-foot radius, passing over the roof of a house in turning the curve. The track then crosses the river, 50 feet above it, on a steel bridge, and enters the mill at the third floor. The construction of the steel bridge over the river presented the most difficult conditions.

On the level ground the track is supported by A bents 35 feet above the ground, resting on concrete foundations. Along the rocky cliffs huge supports of Georgia pine 14 inches square and from 30 to 40

feet long were used, the foundations for which were cut out of the slanting side of the solid rock. These supports are braced by heavy timbers in the shape of a figure 4, also anchored back in the solid rock. A single one of these posts weighs over a ton and a half. The steel bridge which spans the river carrying the track beneath it rests at one end on a tower supported by concrete foundation piers. The distance from this tower to the wall of the mill is 80 feet.

Along the side of a rocky, precipitous cliff, at the foot of which is a swift river.

The telpher, or electric locomotive in this plant, runs on top of the single overhead rail and is controlled by an operator, seated in an enclosed cab which is suspended from the telpher directly underneath the track. The operator has his controller, which is exactly like the ordinary trolley car controller described in the October Popular Mechanics, at one hand, and at the other hand is a powerful brake wheel, which applies the brakes simultaneously to the telpher and all of the trailers which carry the trucks so suspended beneath them, so the whole train can be stopped within its own length. Current is supplied to the telpher through trolley wires, being taken off by a trolley pole.

At the storehouse bags of raw material weighing 200 pounds each are loaded on trucks of 2,000 pounds capacity. The weight of the machine is 4,600 pounds, and with the three loaded trucks, the total moving load on the structure is 12,000 pounds suspended 50 feet in the air along the rocky cliff and over the water. The train is 30 feet long and the average speed is about 700 feet per minute.

The loaded trucks are pushed underneath the machine and the hooks attached. The operator raises the trucks several inches clear of the floor, then starts the telpher with its load of three trucks of 2,000 pounds each, and in three-quarters of a minute has passed by the precipitous cliff and across the river, and has landed his load of 6,000 pounds (three tons) on the third floor of the mill. The three loaded trucks are unhooked from the machine and pushed out of the way and three empty ones are hooked on in their place in less than a minute's time, and the operator is on his way back to the storehouse, where three more loaded trucks are awaiting him. The round trip has not taken three minutes.

By the use of this telpherway one man at $2.00 per day does in a day as much work as was formerly done by many men and teams. The cost of the power consumed by the telpher in operation for 10 hours does not amount to $1.00. Up to a 12-horsepower requirement, a gas engine consuming a few cents' worth of fuel per hour and a direct-connected generator will suffice for ordinary telpherage installations.

Mr. Messer describes conditions which have come under his immediate observation, and which telpherage is designed to economically replace. He says:

"Recently I stood forty minutes to observe the movement of five cases of finished cloth from a packing-room to a storehouse. In the operation six men and two horses were employed. Three men ended the cases upon a truck and wheeled them to the elevator; then a drop was made to

the ground floor. The combined effort of five men was used in getting the cases from the elevator to the platform of a dray. A driver handled the ribbons while the load was moving the 600 feet to the storehouse, the five lumpers being part of the load; then, at the other end of the line, the six men were required in the unloading of the dray and the conveying to another elevator, which in two loads took the material to the second story of the storehouse, where men, not accounted for in the illustration, loaded it again and wheeled it to its resting-place.

"It was rather a singular analogy that inside the buildings of the various departments of the manufacturing plant expensive machinery was being driven to its utmost capacity that the cost of production should be reduced, while here was at least 240 minutes of manual and animal labor expended in a simple problem of conveying. The cost of this operation, not including time of horse, interest on horse, wagon, harness, etc., was at least 60 cents.

"I will tell you what that 240 minutes was worth to the manager of that manufacturing plant and to his stockholders, if an equally careful surveillance had been exercised in indoor and out-of-door economics.

"Fifty cases of the same weight could have been transported between the same discharging and receiving points, the energy employed being a telpher outfit, a telpherman and a helper, and the entire cost, reckoning interest on plant, depreciation, power and wages, would be less than $1. I would like some mathematician to figure the loss in capital energy by reason of the cited carelessness on the transportation side of production."

In decided contrast to this Mr. Messer presents another picture:

"A 10-horsepower gas engine is furnishing electric power for the lifting of a 3,000-pound telpherage load at a speed of 60 feet per minute, and a horizontal run at a rate of 1,000 feet per minute, at an expense of 30 pounds of coal per lifting horsepower hour, and 12 pounds for the horizontal horsepower hour. During a recent test of eight and one-half hours' continual running in a ten-hour day, one-twelfth of the time was occupied in the lift, ten-twelfths in the horizontal run and a twelfth was lost in the changing of loads. The average per hour consumption of coal in the horsepower working hours involved in the problem was 13 7-10 pounds, or an actual power expense of 30 cents for the day's work."

In addition to the telpher lines we have already described there is what is called, technically, a space-covering track. It is a section of track placed between two side tracks, much in the way of a crane, except that the telpher passes upon the side rails across this immovable track to the other side. This enables goods to be raised from any portion of a floor or yard without switches or a multiplicity of tracks.

No other form of freight transportation is of more practical value to the manufacturer than this, which no known power save electricity could have made possible.

OPENED A BANK VAULT BY ELECTRICITY.

The combination of the vault of the Franklin Savings Bank, in Boston, refused to work a short time ago, and when every other means failed electricity was resorted to. The electrical experts were provided with a detailed plan of the bank and began operations during the night.

They made an electrical connection between a carbon and the wires of the power company outside the building, and with a 1,500-ampere current began to melt a hole through the door. The electricians were obliged to wear thick dark glasses because of the intense light made by the white hot carbon. Inside two and one-half hours a hole had been bored through the two and one-half inches of iron, when operations were suspended. Next morning the edge of a bolt on the inner surface of the door was chipped off by steel instruments and the door at last swung open.

LATEST FOOTBALL ARMOR.

Much like a knight of old now sallies forth the football player to battle for his college colors. The latest in this line is a patent football pants and suit. The garment is padded with felt at all points where protection is most needed. There are five grades ranging from army duck to expensive moleskin of the best quality obtainable. The pants and jacket are connected by an elastic belt which permits of free movement of the body. The pads have a great advantage over the old style which had a tendency to move out of place just when they were most needed.

Bucket Tramway in Mountains of Washington

Unique Conveyor a Mile Long--Descends 1,700 Feet--Is Self-Propelling

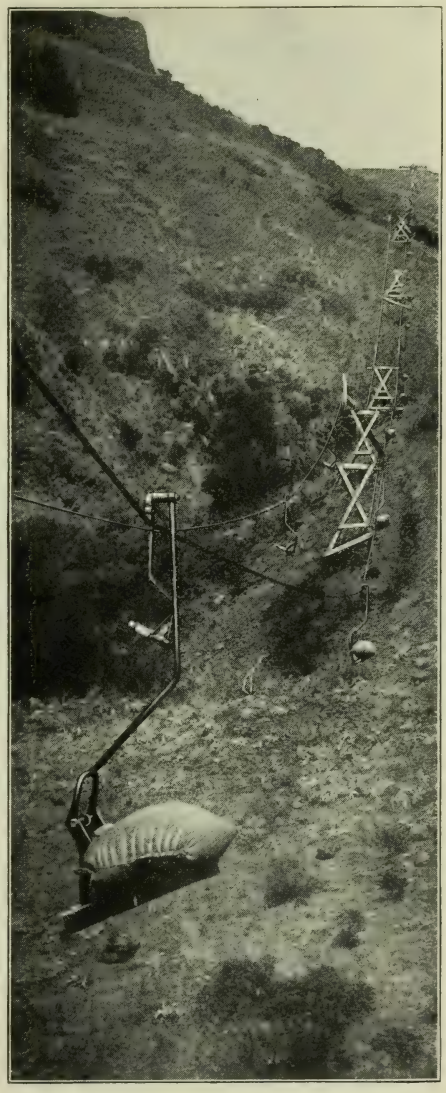
If some of the wheat grown in our great western fields could tell the story of its journey from the field across the country, through the vortex of the Chicago market and on across the ocean to the masses in Europe whose food supply annually depends on the American product, no doubt some strange methods of transportation would go on record, but no chapter would be stranger than the method by which it was conveyed from the big warehouses built at the top of river bluffs down those bluffs to the vessels waiting below.

When one thinks of the enormous product, the words "bucket tramway" convey an idea of an apparatus wholly inadequate to handle any great proportion of that product, and yet, far from being an insignificant apparatus, along the river bluffs of the great Northwest these bucket tramways convey hundreds of thousands of bushels of wheat every grain season, saving the farmers far around miles of hauling over rugged roads and rolling country.

One of these tramways is in operation at Wawawai, Washington, on the Snake river, carrying great quantities of grain down the steep bluffs of that river, a distance of 5,150 feet, from an altitude of 1,700 feet, to the warehouse and the steamers at the foot of the bluff.

Two immense warehouses were constructed, one at the top of the bluff and one on the bank of the stream, and between these operates the tramway. It consists of a strong steel wire cable, capable of supporting a very heavy strain. This endless cable is nearly two miles long, and is supported at frequent intervals, each support having a lubricated iron pulley, over which the cable runs. Strung along the cable at intervening distances of 80 feet are carriers, each capable of holding a sack of wheat. There are 128 of these carriers, so that 64 are constantly descending to the lower warehouse loaded, while 64 others are ascending to the upper warehouse to be reloaded.

This unique contrivance is operated by gravity, without the aid of any other power. At the upper terminal of the tramway is a large cast-iron wheel, 8 feet in diameter and supplied with a patent rachet grip, through which wheel the cable passes. A smooth band-iron grip-brake regulates the speed.



Conveying Wheat Down The Mountain

The construction at the lower terminal is the same. When in operation a man at the brake lever controls the entire tramway at all times. The sacks of grain are placed in the carriers as they pass, the loaded carriers

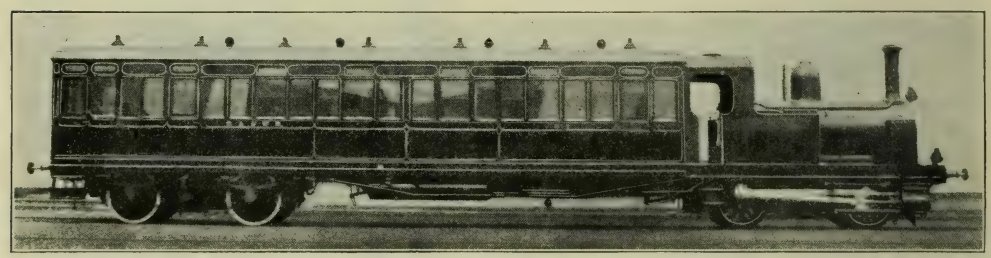
keeping the cable running, and down the side of the rugged, towering bluffs are continually passing the bags of good grain. The carriers are unloaded in the tower of the lower warehouse, and from thence the grain is carried in chutes to any section of the huge building desired, or, perchance, to the steamer in waiting.

This tramway can easily convey 200 tons of grain in ten hours, and during a grain season frequently handles from 75,000 to 80,000 sacks of wheat. The farmers for miles around haul their grain there, as it saves them trips of from fifteen to twenty-five miles to the nearest railway station.

COMBINATION LOCOMOTIVE CAR.

Will Be Tested on the Glasgow & Southwestern Railroad

With a view of securing more frequent service by running single cars instead of trains, James Manson, superintendent of



Steam Motor Carriage for Local Traffic on the Glasgow and Southwestern Railway

motive power on the Glasgow & Southwestern, has designed the novel combination shown in the illustration. Page's Weekly, London, says:

The car, which is 60 feet 8 inches long over the buffers, is divided into three passenger compartments, and a special compartment for the steam motor; the one at the rear is a guard's compartment, the two adjoining being reserved for passengers. At the guard's compartment, steps are provided to enable passengers to enter from the road level, and these are so arranged that they can be brought into use by actuating a lever in the guard's compartment. Seating accommodation is provided for fifty passengers of one class, the seats being so arranged that there is a free passage from end to end of the car. Electrical communication is provided for the convenience of the guard and driver. Hand and vacuum brakes, which can be operated from either end of the vehicle, are fitted to each bogie, and in addition the steam whistle can be sounded from the guard's compartment.

ELECTRIC VS. STEAM LOCOMOTIVE.

Will the electric railway replace the steam locomotive?

Perhaps the best answer is that its future is not in the wholesale destruction of existing great systems. It is in the development of a field of its own, with recognized limitations, but of vast possibilities. It will fill that field to the practical exclusion of all other methods of transmitting energy; it will operate all street railway systems, and elevated and underground roads; it will prove a valuable auxiliary to trunk systems, but it has not yet sounded the deathknell of the locomotive any more than the dynamo has that of the stationary steam engine. Each has its own legitimate field, which will play its proper part in the needs of all civilization.—Frank J. Sprague, International Electrical Congress.

OIL PRODUCTION THE PAST YEAR.

The total value of raw petroleum produced in the United States last year was $94,694,050. Ohio led with $23,515,140; West Virginia, Pennsylvania and Indiana followed in the order named. Texas and California each produced over $7,000,000. During the year 18,880 wells were drilled, of which 4,650 were dry; these wells cost $26,402,000. The exports of petroleum and its manufactured products were $72,628,539, an increase in value, but a decrease in quantity as compared with the preceding year.

"Bends" or the Caisson Disease

Men Who Work in Compressed Air Suffer Agonies--Many Deaths Result--Science Investigates the Cause

In sinking the foundations of bridges, or in any work which must be done on the bed of the sea or of a river, the men work in a caisson, or large steel cylinder, which is sunk in the water, the water being kept out of it by means of compressed air. The bottom of the caisson is open, but the top is closed and men and materials enter through an air-lock, a chamber in the top of the caisson, which is fitted with airtight doors and cocks. By means of these cocks the air in the caisson is compressed or decompressed as required and at any rate desired. The large cock is used for rapid decompression during the passage of materials, but with men there is a deadly menace in rapid decompression, especially if they have been in the caisson some time or have been working under great pressure. Therefore a small cock is provided for slowly decompressing humans, though often the workmen are in such a hurry to get home that they scorn the dangers and make use of the large cock in order to get out of the air-lock quickly.

The men are never taken ill while under pressure, but often shortly after decompression some poor fellow is seized with terrible muscular pains, with cramps, his skin becomes icy cold and he breathes with difficulty; sometimes the pains in his limbs are sharp and shooting so that he is unable to walk and suffers agonies. Such cases generally recover in a short time, though they are apt to suffer again in a similar manner if they go back to the caisson; in fact, in severe cases, the employers, fearing the employes will die in a second attack, discharge them. Again, a laborer who has been decompressed perhaps an hour before, suddenly falls unconscious and lies a cold, livid, inert mass. Some parts of his body are sure to be paralyzed, the pulse is irregular, the heart-beats scarcely audible, the pupils of the eyes do not move. Perhaps the attending physician tries bleeding the patient; his blood is black. Such a case is inevitably followed by death. This terrible disease, which men brave in order to earn bread for their families and themselves, is known among workmen as the "bends" and among physicians and scientists as the "caisson disease."

The construction of every bridge where the caisson is used for the foundation work adds to the list of those who die or suffer from this disease. At Brooklyn Bridge there were 110 cases of illness with three deaths; while sinking the foundation of the Eads bridge across the Mississippi at St. Louis, of 600 workmen there were 133 who suffered from bends in varying degree, of whom 14 died. Of 64 men employed in a caisson on the banks of the Loire, 25 had bends, 16 having serious attacks and two dying. This latter instance occurred as far back as 1854, but time has not bettered conditions, nor removed the cause. The following paragraph which appeared in one of our reliable newspapers during the present year repeats the story:

> NEW YORK, Sept. 17.—That fourteen men have been killed in the new Manhattan bridge caisson within fourteen days was learned today during a discussion by several British engineers, who were inspecting the south tunnel under the Hudson river. The deaths have been kept quiet, as it is hard to get men to work in the caisson. Death in every case was due to the caisson disease, paralysis resulting from working in the high pressure chambers.

These are terrible statistics for this day and age, and engineers, contractors, scientists, physicians, men of prominence everywhere are taking note of the fact and investigating it. Even the lawyers are interested, as it presents opportunities for endless litigation.

For every 33 feet of depth that the caisson is sunk in water, +15 pounds pressure to the square inch or +1 atmosphere is required to keep the water out of the caisson. Therefore if the depth were 100 feet, the pressure would be 45 pounds to the square inch. The effects upon the system while under pressure are all of a minor character, more of the nature of inconvenience than of injury. The pressure has no mechanical effect on the circulation. It causes pains in the tympanic membrane, which are relieved by opening the Eustachian tube, the pulse and the respiration are slower and there is a feeling of resistance to movement, due to the density of the atmosphere. One cannot whisper under pressure, and if he whistles he can hear no sound.

An old Scotchman who worked in one of the Blackwall tunnel caissons where the

pressure was as high as 37 pounds to the square inch gives a graphic account of how he felt while inside the caisson:

"We stayed in for eight hours at a shift. We had half an hour for dinner, but some of the men would not come out for it. They took it inside with them. Coming out again it was not so bad, but just chilly; bitter chilly, cold as charity. The pains would come on afterward, in an hour or so, or when you got into bed. Bends in the back, and the wrists, and the legs; just awful. Men would turn out in the middle of the night and come back to the works and get into the compressed air again in the medical locks. They had a full dose of it for a start, and let the pressure drop gradually. Then they went back home to bed. Do them any good? Eh, mon, it's no for me to say. They said so, but I thought it was only humbug, a faith dodge. When I had bends I just jumped about and took a drap of guid whuskey.

"I never felt happier than when I was in the compressed air. Always happy, and on the cheery side. Why, laddie, I would get up in the morning feeling very dour and queer, and just go into the workings, and then whistle and sing all day long. Not that you could hear the whistling, at least a man with my lungs, when the pressure was over twenty-five.

"The worst thing that could happen was for the electric light to fail. Then they burnt candles, and the mixture of smoke with the air gave them 'bends' of an extra special vigor. You nodded and didn't care if you went to sleep forever, though it was all very nice and dreamy. When I was alone in that 'casoon' I had to rope myself up lest I should fall asleep and tumble to the bottom, 60 feet below. It was better under the river than in the 'casoons,' because under the river the air could escape into the Thames. Tobacco had no sting. The only stuff that had any flavor was four-ale. You weren't allowed to take it in, but you did. But you had to take the cork out first. If you didn't the bottle would burst. The finest men in the tunnel were the first to be knocked out. The men of delicate appearance stood the pressure best."

The results of a thorough investigation of this subject made by Leonard Hill, M. B., F. R. S., lecturer on physiology at the London Hospital, and J. J. R. Macleod, M. B., professor of physiology at the Western Reserve University, Ohio, was recently published in the Journal of Hygiene.

These authorities declare that the cause of the caisson disease is the escape of gas bubbles in the blood vessels and tissue fluids on decompression. These air bubbles coalesce and increase in size and, flowing on with the blood, gather at all the high points, just as in a pipe system, and there remain until forced at a gulp toward the heart. If sufficient time is taken in decompressing the men they do not suffer from bends, but the length of time of decompression must vary with the length of the shift. The disease has a wide variety of symptoms: pains in the limbs, vertigo, nosebleed, embarrassed respiration, hemorrhages, intense cold due to the expansion of the air, loss of muscular power, paralysis, some cases even have become disabled for life, amputations of limbs being necessary. Diver's sickness comes under the same class.

Is it at all strange that caissoniers are hard to get? But there is a means of preventing this terrible disease that maims, disables and destroys. The first step rests with the employer himself. Let him see that the airlocks on caissons have adjustable locked escape valves so that the men cannot get out in less than sufficient time for decompression. Let him see that the time of decompression does vary with the depth of excavation, and the pressure of air and let him make sure the shifts are not too long.

Men not older than from 20 to 25, small, spare, and totally absteminous, should be employed. It is no place for old or fat men. After a test at low pressure all who suffer from symptoms should be discharged. The longer the shift, the greater is the saturation of the body fluids with gas, and the slower therefore should be the decompression. The higher the pressure, the shorter should be the shift, and the longer the decompression period. For a pressure of +2 or 30 pounds the shift should be four hours and the decompression period from 30 minutes to one hour; for a pressure of +6 to 7, or 90 to 105 pounds, about a 45-minute shift and a decompression period of two hours. The decompression chamber should be artificially warmed and the temperature not allowed to fall below 60 degrees F.; ventilation should be thorough during decompression. The caisson should also be freely ventilated and kept at a temperature of 60 degrees F. The men should remain quiet for an hour after decompression and if symptoms appear should be hurriedly recompressed. If these rules were followed strictly it is safe to say that there would be few fatalities from this disease.

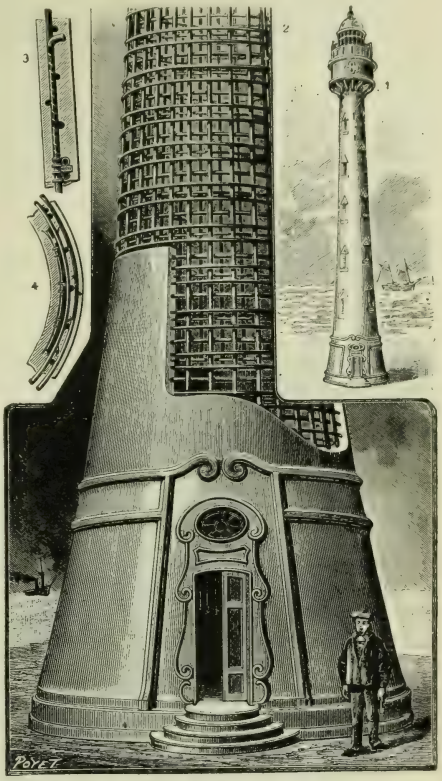
TALL BETON AND STEEL LIGHTHOUSE ERECTED BY RUSSIAN GOVERNMENT.

A recent consular report declares that beton is believed by German contractors and manufacturers to be the coming building material, in that it is cheap, durable and the least susceptible to fire of all building materials now in use. Beton is not, however, a new building material. It was invented by M. Coignet, a Frenchman, who spent many years experimenting with it, and some of the most interesting exhibits at the Paris Exposition in 1867 were of this artificial stone.

It is so much like concrete that it is often confused with that stone. Beton, however, is composed of from four to five parts of clean silicous sand, neither too fine nor too coarse, one part of either common or hydraulic lime and hydraulic cement, one-fourth to three-fourths of one part in volume. These solids are thoroughly mixed with just enough water to convert them into a stiff, viscous paste, so that every grain of sand or gravel is coated with a thin film of paste, and is then rammed into moulds with heavy iron pestles. It is an artificial stone of great strength and hardness and has been in the past used extensively in submarine works. Its great property is that it successfully resists the solvent action of the salts and certain gases contained in sea water, and is not injured by climatic influences and changes. For instance, freezing serves only to detach a thin scale from its outer surfaces, leaving it slightly rough and somewhat unsightly, but otherwise perfectly capable of holding its own for long years against storm and tide.

The first important lighthouse to be constructed of beton and steel has just been completed by the Russian government at the entrance of the canal which connects the fort and naval base of Nikolaev with the Black sea. This lighthouse is 132 feet, 2 inches high above the ground, and one of the strongest in the world. It is paraboloidal in form and rests upon a massive base of beton 19 feet, 8 inches in diameter, 7 feet, 2 inches high, encased in steel, covered on the outside with beton and buried in the ground to a depth of 8 feet, 2 inches. At the base the lighthouse tower is 20 feet, 8 inches in diameter, and 6 feet, 6½ inches in diameter at the crown.

The coating of beton on the tower walls is comparatively thin, at the base being only 7⅞ inches thick; at a height of 40 feet, 5⅝ inches thick, and at the top 3⅝ inches thick. The great strength of the tower depends not on the beton, but on the steel frame which the beton encases and protects from corrosion. This is composed of transverse and longitudinal steel bars



Beton and Steel Lighthouse Erected by Russia

nearly an inch in diameter, the transverse bars being in circular sections and sunk into the beton to a depth of 1.18 inches. The bars are closer together towards the base than at the top; Figs. 3 and 4 show the manner in which they are joined.

At the top of the tower there is a large room which serves as a storehouse and also for the keepers to keep watch from. Above this room is the lantern tower and the whole is surmounted by a cupola.

The total weight of the lighthouse, including the filling of beton in the massive foundation is estimated at only 507 tons, its cost was but $6,270 and the time required for constructing but two months.

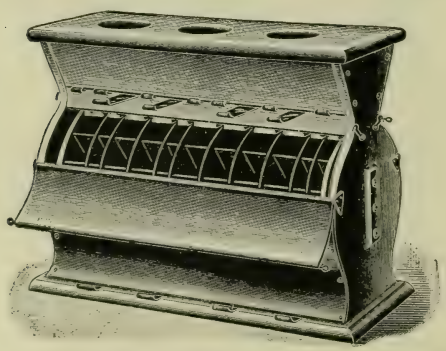
The superiority of this construction for such purposes is being widely discussed.

Beton is much more generally used than hitherto for public buildings and even residences. One of the most important works in which it has been used is a section 37 miles long of the Vanne acqueduct for supplying water to Paris. This aqueduct passes through miles of the Fontainebleau forest and comprises from two and one-half to three miles of arches, some of which are 50 feet high; eleven miles of tunnels and eight or ten bridges of spans from 75 to 100 feet.

The cost of this artificial stone varies with the cost of lime, but all the substances used in it are so generally obtainable that in almost any country it is comparatively cheap.

BEST FLOUR FROM MIXED WHEAT.

In flour mills one grade alone of wheat is seldom used, but a process of what is termed blending is resorted to. This has heretofore been accomplished by elevating the various grades of grain into bins, from which it runs down in spouts. By opening and closing these spouts the proportion of the several grades is secured. A machine



Autcmatic Wheat Blender

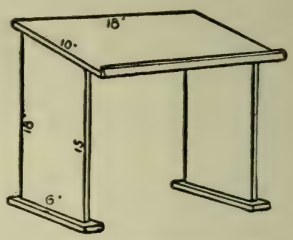
has now been devised for blending which can be adjusted to a nicety.

The machine is very simple in construction and consists of a cylinder with compartments of different sizes fed by drawing a slide over each. In this manner the flow of the grain is regulated and the amount going to each compartment can be accurately adjusted. It is operated by gravity.

Many fishermen are using graphite for polishing their lines. It renders the lines more impervious to water and greatly facilitates the movement of a line in casting.

A DESK FOR A CHILD.

The little desk shown in the illustration is just high enough for a child when seated in its chair to draw over its lap and rest slate or book upon. It is an exceedingly comfortable piece of furniture for the tot who has just started to school and spends



Child's Desk

many minutes laboriously trying to write. All materials for such a desk could be found in most homes. It is made of three pieces of board, a molding for the front, and the top covered with cretonne put on with brass-headed tacks. The sides may be stained and so made much more attractive.

HIGH SPEED REQUIRES SINGLE CARS.

German engineers have decided that very high speed must be made by single cars; there is too much danger of the trailer jumping even a straight track. The power required makes the service expensive. Who would think that the soft balmy air of a June morning would alone offer a resistance requiring 1,100 horsepower in addition to the 200 horsepower necessary to propel one car when moving at 120 miles an hour. Such, however, is the carefully made record of the celebrated experiments with an electric car at Zossen. A standard gauge electric surface line is to be built connecting Berlin and Hamburg, a distance of 160 miles. The trip will be made in two hours.

The Wall Street Journal says: "There will continue to be a tendency toward heavier coaches so long as trains run on present track. The lateral oscillation of wheel flanges and the tendency to lift the train free of these flanges when passing over irregular track at great speed are objectionable."

The Railway Age says: "As the schedule speed increases, the weight of train and the number of cars decrease, and it is not possible to haul present trains of eight or ten

Pullman cars at sustained speeds of 65 or 70 miles per hour with either steam or electric locomotives. Electric traction at a speed exceeding 100 miles per hour will probably be with a single car, and such a car with motors sufficient for the purpose, and capacity for the necessary number of passengers to make it profitable, will be heavy enough to hold itself down to the track of regular gauge, and it will not be necessary to resort to the more expensive construction required for the mono-rail."

GOATS ON ARIZONA RANGES.

Goat raising is on the increase on the ranges of Arizona, says a bulletin recently issued by the Bureau of Plant Industry. The carrying capacity of Arizona range lands are stated to vary from one bovine to 50 acres to one to 100 acres. Goats on these ranges live upon oak brush principally and from their hardy character they are better adapted to the arid country than most other domestic animals. Cattle frequently travel 10 miles from water to feeding grounds, making a distance of 20 miles between waterings, while sheep are often herded at a distance of six miles, making 12 miles' travel for them. Sometimes when the distance is too great, the ground near an arroyo will be thickly strewn with the carcasses and skeletons of dead cattle.

Goats Feeding on Oak Brush on an Arizona Range

ENGLAND ENCOURAGES COTTON GROWING.

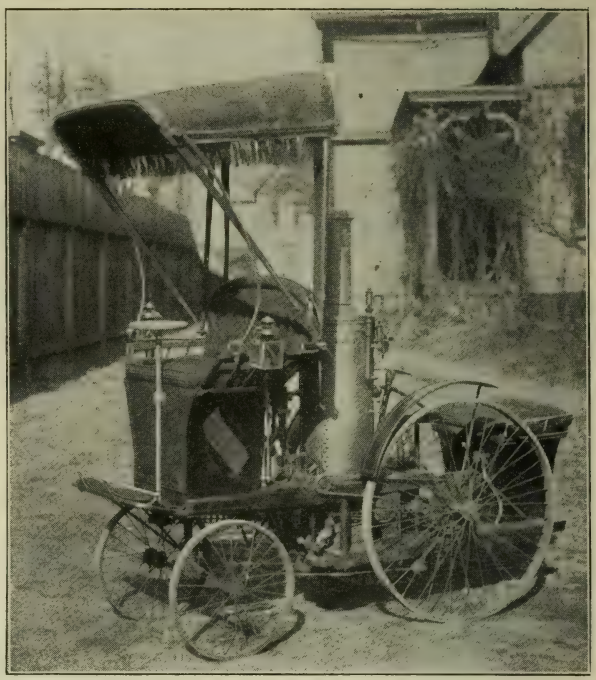
England is making extraordinary efforts toward the promotion of cotton cultivation in the West Indies. Four thousand acres are to be planted with cotton in the Windward and Leeward Islands and Barbados. Cottonseed is furnished free. The government is aiding in the establishment of factories for ginning and baling. The first of these factories has just been completed at Bridgetown, Barbados; another is being built at Antigua and a third is to be built at St. Vincent.

AUTOMOBILE SCHOOL FOR HORSES.

It is not a difficult task to educate the average country horse to understand an auto will not harm him, if only one will take the pains to train him. The Motor Age describes such a school for horses which a lover of horses—and autos—conducted the past summer on Mt. Washington. The first lesson was to run the automobile into the stable containing more than 100 horses. At first there was a great commotion, some of the horses even laying down from sheer fright. Feeding sugar to the horses from an automobile was one of the alluring lessons which worked well. One week's training was sufficient in most cases.

FIRST AUTOMOBILE IN THE UNITED STATES.

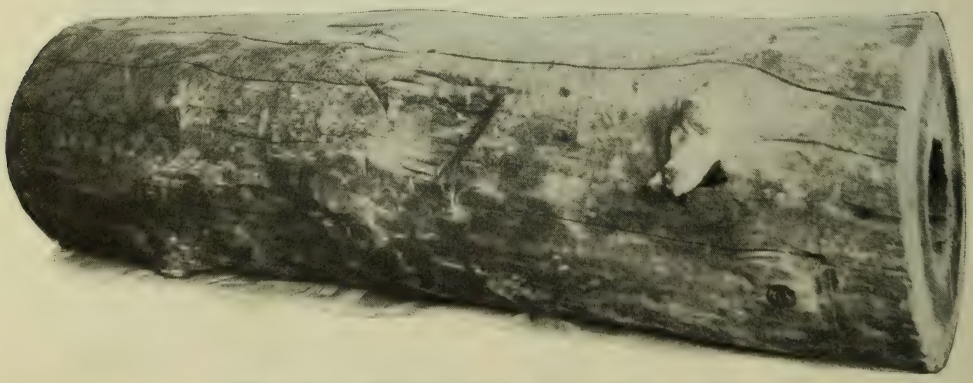
What is claimed to be the first automobile built in the United States, is still in operation and is owned by Achille Philion, of Akron, Ohio. It was fourteen years ago that he had the machine built under his direction. The picture affords a very fair idea of the construction. The motive power is steam; the upright boiler burns coal; the engine is one horsepower; and the wheels are wire-spoke with flat metal tire. The steering wheel is quite similar to present practice, while the whistle is something of a novelty. Two persons find comfortable seats in front, and the rear seat is for the engineer who is also fireman, and who controls the operation of the engine.



Claimed to Be the First Auto

Piece of the Water Main Used in New York City 107 Years Ago

While workmen were excavating in the New York subway, they came across a piece of wooden water pipe which had been laid in 1776 and which represents a part of the water system of that great city 107 years ago. The piece in the photograph is four feet long. The entire piece uncovered measured 20 feet in length. This was part of a main supply pipe. The diameter of the log is 30 inches and the diameter of the hole through the center of it is three inches. Just how this hole was bored through a 20-foot length would no doubt be interesting to know. This old pipe was unearthed at a depth of 40 feet. It is in a good state of preservation. New York's water supply 107 years ago is said to have come from springs in the vicinity of Canal street.



Wooden Water Main 107 Years Old

The Gas Engine on the Farm

That handy machine, the gas engine, which has filled so many niches and is adapted to so many requirements in the various crafts, is nowhere growing in favor more rapidly than on the farms of America, and in a short time undoubtedly will be classed as a necessity among the equipment of farm machinery. The farmer has learned many things since the telephone did the pioneer work and brought the rural districts into closer touch with metropolitan centers, and not the least of these is that he has long been the slave of much needless drudgery.

One of the great advantages afforded by the gas engine is that the man who has but a few acres to cultivate need not buy a powerful engine, but can secure one of just the horsepower that will do his work. If he has 80 acres a 2½-horsepower engine will be amply capable, but if he owns a quarter-section, he will need not less than a 4-horsepower size. It is astonishing the amount of work the 4-horsepower engine can perform. It will operate the washing machine, the separator, the churn and the pump all at once, if desired, and with a great saving of human energy. In a single day it will shell seven or eight hundred bushels of corn; it will grind two bushels of corn an hour for each horsepower used, and in running the wood saw it will require three or four men to handle wood enough to keep it busy.

On a great many large farms an 8-horsepower traction engine is used for drawing the binder and a gang plow and for running the shredder, feed grinder, wood saw

Fig. 1

and ensilage cutter, while a 2-horsepower gas engine is used for the lighter work, such as running the grindstone, emery wheel and churn and for pumping water. In cold weather the water is pumped direct to the drinking tank and the stock accustom themselves to the drinking hour once or twice a day.

The farmer with but 80 acres or so of land stands more in need of a gas engine, however, than does the operator with the larger farm who has his traction engines and other up-to-date appliances to fall back upon. A 2½-horsepower engine will pump

Fig. 2

the supply of water for the entire farm, the water being piped to house, barns and grounds as desired, and it will run the churn and the grindstone while pumping.

A correspondent of the American Blacksmith tells how he mounted such an engine on some 18-inch plow wheels which he procured of a junk dealer and when shelling corn first located the sheller wherever he wanted it and then located the engine accordingly. He says:

"We use a two-hole sheller, wagon box elevator and wagon box cob carrier. It takes about half of its power to shell fifty bushels an hour; the engine is moved around as easily as an empty wagon. The feed grinder is a six-horse size; it will take all the work there is in the engine. It will grind from four to eight bushels an hour, according to condition of grain, the condition of grinding buhrs, or the fineness ground; usually five bushels an hour, about two hours a week. The words 'no smoke, no ashes, no engineer' clearly express the facts, for once understood it is easily managed, and will run for hours without an attendant. A gallon of gasoline will run my engine for the pump about twelve hours; it costs less than one cent for gasoline to grind a bushel of grain. In the spring, when chicken feed is wanted, and in the fall, when new mush is wanted, I do grinding enough for others to buy my gasoline for most of the year; the expense is so small that it would not get an accident

policy on your life to climb a wind mill tower to oil it. One day when husking, a hydrant was left open. We came in from work at night. There was no water, and no wind to run a wheel. The engine was started and in a few moments there was water for things, and by the time chores were done there was three or four days' supply of water on hand."

In the accompanying sketches we show several methods of fitting up wood sawyer's outfits with the gas engine. The portable

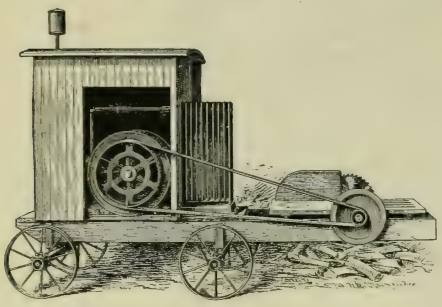


Fig. 3

outfits when fitted up with an engine of from 4 to 10-horsepower are suitable for sawing logs as well as cord wood and so are especially adapted for taking into the timber.

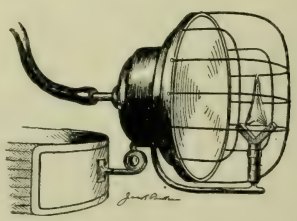
On a great many farms much of the repair work is done in the farmer's own shop and in many of these shops the work is heavy enough to admit of the use of the gas engine. In Fig. 1 is shown a wood-sawing outfit geared to the engine which is stationed within the shop. The size of the circular saw of course varies with the size of the wood to be handled, and the size of the saw or wood determines the amount of power necessary to run the saw. With soggy wood greater power is required than with clear-grained wood. For handling cord wood a 22 or 24-inch circular saw with a heavy balance wheel of from 25 to 100 pounds and run by a 2 or 3-horsepower gas engine is large enough and will saw from 10 to 30 cords of wood per day, according to the amount of help engaged in handling the wood. There should be one man to operate the saw and another to deliver the sticks to the saw table. Larger saws require more power; for instance, four horsepower would be required for a 26 or 30-inch saw and, in fact, a 5 or 10-horsepower engine could be used advantageously with greater speed and more rapid work.

In the portable outfit, shown at Fig. 2, a 3-horsepower water-cooled engine is used. In the case of a water-cooled engine there is risk of the cylinder freezing in cold weather and therefore the water tank must be emptied when shutting down and refilled when the engine is again started up. The tank holds but a couple of pailfuls of water, so the work of emptying and filling it is slight.

The outfit shown at Fig. 3 has a 6-horsepower oil-cooled cylinder so that the trouble of emptying and refilling the cylinder is done away with. The construction of each of the portable outfits is apparent in the illustrations and, of course, each is capable of being modified or changed according to individual circumstances. A search through the junk pile will probably yield all the materials required outside the saw and the engine, and with the aid of a farm hand any farmer can fit up such an outfit in half a day's time.

SURGEONS' ACETYLENE HEADLIGHT FOR OPERATING AT NIGHT.

In the modern hospital the operating room is specially equipped to secure the greatest possible amount of light, both day and night. The walls are of the finest and whitest enameled brick obtainable, and a large skylight by day and innumerable electric lights at night simply fill the room with a bright light. A skillful surgeon can, in emergency, get along without many of the most helpful appliances, but he must have light.



For the special assistance of surgeons who are obliged to operate at night outside of the hospital, Dr. Kane has devised an acetylene light which throws an intensely bright light just where it is most needed. The burner and reflector are worn on the forehead of the operating surgeon, and the gas conducted through a small tube which runs down the doctor's back to a little generator fastened to a belt at the waist.

SHOP NOTES

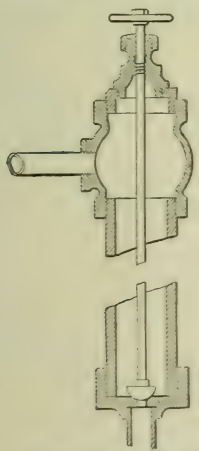
HOW TO MAKE A STEAM TRAP.

A steam trap should always be open when empty, so that when the steam is turned on the water will drain out of the pipes and the pipes can drain themselves after the steam is turned off.

The home-made trap shown herewith includes this advantage and also has the advantage that by the valve arrangement in its top the amount of steam can be regulated according to the requirement.

It consists of 3 feet of 2-inch pipe with a cap on the bottom and a cap on the top, and the stem and gland of a ¼-inch valve inserted in the top. That stem is attached to a brass rod 5-16 inch in diameter.

On the bottom of the rod is a little hemispherical piece of packing, which is sufficiently hard to resist the action of steam. Anything softer than this, the steam will melt away. The ratio of expansion of brass and iron is practically as three is to two; that is, you will have three points of expansion in brass to two in iron. Steam at 50 pounds pressure contains 297 degrees of temperature. Taking 200 degrees as the difference between the inlet steam and the outlet water, a 30-inch trap gives nearly 1-32



Home-Made Steam Trap

inch in expansion, which is sufficient to drain the trap.

Turn the steam on, and the water will come out of the half-inch pipe and fill the pipe at a low pressure. As soon as the steam begins to come, the rod will close the valve entirely. After that it will open itself slightly and allow the water to trickle out in a hot stream.

HOW TO STRAIGHTEN PAPER.

Who has not been annoyed by blue prints, drawings or other papers which, having been rolled for some time, refused to lie flat when in use? And yet it is a very

To Straighten Paper

simple matter to straighten the paper so that it will give no more trouble.

Hold the paper by the corners or by the ends and draw down over the sharp corner of the drawing board or table, or else lay the hand on the sheet at the table edge and draw the sheet through with the other. In this way it can be easily straightened. The illustration is by courtesy of the Draftsman.

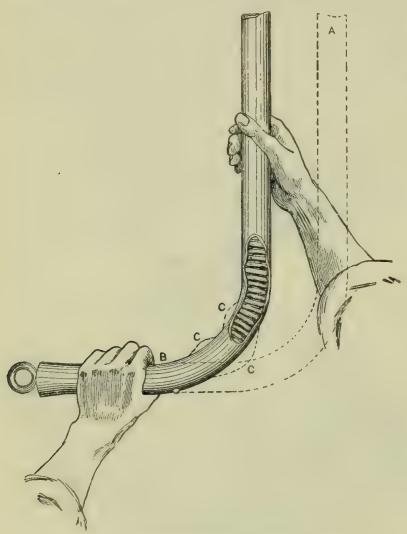
FORMULA FOR WHITE METAL.

A formula for making white metal for motor bearings, which has given excellent results on heavy high-speed service, is given in the Mechanical Engineer, of London, and consists of 48 pounds of tin, 4 pounds of copper, and 1 pound of antimony. The copper and tin are melted first, and then the antimony is added.

PROPER METHOD OF BENDING LEAD PIPE.

Making bends in lead pipe is not difficult, but to make a neat round full-sized bend the workman should be properly equipped with bending tools, says the Metal Worker.

The rubber bender on the market today, consisting of a piece of solid rubber 18 inches long with a rope molded into one end, has certain disadvantages. In use, it is greased and inserted in the pipe to be bent which is then bent over the knee, giving a



Bending Lead Pipe

sweeping curve. There are many instances where a square bend is necessary, but this cannot be had by use of the rubber bender without heating the pipe, which in time injures or destroys the bender, also there is not enough heft in the bender to allow of the pipe being dressed sufficiently to compensate for the thickness in the heel of the pipe. A very important point.

The spring bender, consisting of a spiral spring wound close together with a loop at the end for removing it, and usually, 24 inches long is, generally speaking, much handier.

Before making a bend with the spring drift out the pipe and dress smooth. Grease the coil bender and place full length in the pipe and then, with the handle of the dresser, strike the pipe at the point where the throat of the bend is to be, hard enough to dent the lead slightly. Heat the throat of the bend and the pipe for four inches on each side of the heel of the bend over the furnace until it is so hot that water splashed on it will fly off. Place the pipe on the floor and hold a piece of carpet or a bunch of rags tightly in the throat with the left hand while the right hand bends the pipe up to an angle of about 45 degrees, thus thickening the lead in the throat and thinning it in the heel. Dress out any kinks that may show up by striking the lead in such a manner as to draw any surplus lead from the throat to the heel.

Heat the lead as before; with one hand grasp the short end of the bend close to the throat and with the other hold the long end upright and jump or pound the pipe on the floor, as shown in the sketch. Strike a few sharp blows on one side, reverse the pipe and repeat the operation on the other end, occasionally dressing the lead from throat to heel. In pounding the lead on the floor, strike with a sliding motion, thus forcing the lead from the pipe to the heel (C C C). The bend will soon be square and the pipe should then be dressed perfectly smooth.

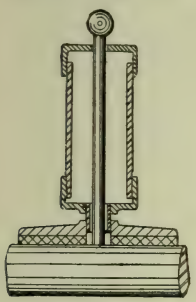
To remove the spring insert the bending iron into the loop of the spring, place the foot on the pipe as close to the throat as possible, and then proceed to twist the spring as though winding it up. It will reach a certain tension and then turn suddenly, when it will be as tight as before. Now twist it again, and just before it turns commence to pull, and at the same time keep twisting. If the pull is kept up until it turns, it will spring out about six inches, after which the operation must be repeated until the spring is removed. After the knack of pulling at the right time is acquired, there will be little trouble in removing the spring.

When a bend is to be made in the center of a long pipe or when a spring cannot be had, the old time sand method is a handy thing to know. The sand should be clean and fine. Place it in a pan and suspend over the furnace to heat it hot. Close up one end of the pipe to be bent by soldering or beating over the edges of the pipe as far as possible. Ram a small bunch of oakum down the pipe to fill up the hole. When the sand is hot pour it into the pipe to the depth of a foot at a time and pack thoroughly by dressing the pipe till the sand will stand no more. Close the other end with either a wooden sand plug or as the first one was closed, being careful to dress the lead down tightly on the sand so

the sand will have no room to loosen up and cause kinks in the pipe when bending. Make the bend just as it is made when using springs. Do not press hard on the bend, but strike light blows. Hard blows will cause the lead to spread and so loosen the sand; light blows set the lead up against the sand.

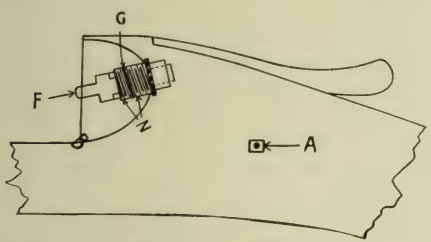
HOW TO MAKE A GREASE CUP.

Take a 1½-inch nipple about 4 inches long and on each end screw a cap. On the cap leading to the bearing there should be a ½-inch nipple and the top cap should have a hole for the brass rod to pass through. The rod is heated by the friction between it and the shaft and this causes the grease to flow down it to lubricate the bearing. The cup is convenient for bearings which are not attended to often, says the Practical Engineer.



WANTS TO REMOVE BROKEN FIRING PIN.

I have noticed several "kinks" in the line of getting out broken studs, screws, and tapper pit rods, but have never read of one just like the one in sketch I enclose, and would be pleased to hear from some of your

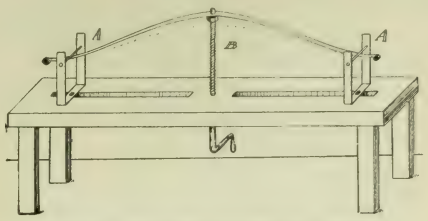


A. Hammer Stud.
B. Breech Block.
G. Position of Cock.
F. Firing Pin.
N. Nipple.

readers as to how they would get at it. The firing pin is slightly damaged and must be gotten out, but only the fore part of the nipple can be turned out in the ordinary manner.—Wm. Nak, Rural Route 14, Grand Rapids, Mich.

HOW TO SHAPE CARRIAGE SPRINGS.

There are only a few carriage smiths, nowadays, who make their own carriage springs, but it is, nevertheless, convenient to know how to do it, and there are out-of-the-way places where the smith is obliged



Device For Shaping Carriage Springs

to make his own springs for every job he builds.

The device herewith shown is handy for shaping the springs after the heads for the main leaves have been made, the smaller ones drawn to taper, the center holes drilled and the ribs and grooves for keeping the holes in place made, says a correspondent of the American Blacksmith.

In shaping the springs in the device hold the ends in place by means of bolts passing through forked irons, as at AA. Force the center up slightly as at B by means of a screw. Heat the second leaf its full length and then with tongs and clamps, bend it to fit the shape of the main leaves. Shape the remaining leaves in the same manner over the one preceding each, moving the forked irons closer together as required, according to the length of the leaf.

All springs should be tempered, but the tempering cannot be done satisfactorily in an ordinary forge, for in order to obtain a uniform heat the full length of the leaf, the fire must be long enough to heat it all at once and not too quickly, but gradually, to be sure the heat penetrates the steel. A coke furnace is best for the purpose, heating the spring as for bending and performing the work quickly, then spraying the leaf with water until it is nearly cold. This is sufficient for cheap grades of work, but for the better class the springs should be oil tempered. To do this fill a trough or tank, large enough to allow of dipping the leaf until cold, with linseed oil. After dipping the leaf, draw the temper by placing it over the fire until the oil is burned off.

A good shellac varnish is made of 3½ pounds orange shellac thoroughly dissolved in 1 gallon of wood alcohol.

RECIPE FOR MARINE GLUE.

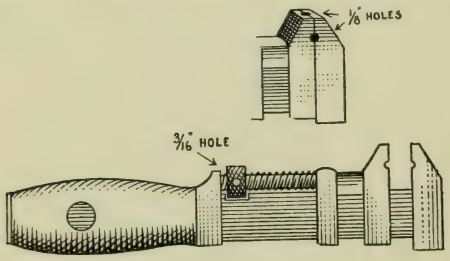
One part of pure india rubber dissolved in naphtha. When melted add two parts of shellac. Melt until mixed. Pour out on tin until cold. Melt and use with a brush at water-bath heat.

Or take a handful of quicklime and four ounces of linseed oil. Boil, and pour out on a plate until hard. Melt and use.

Or take one pound of common glue—not fish glue—in two quarts of skim milk. Soak and boil. All these are good.

TO USE WRENCH AS HAND VISE.

A clever idea comes from W. I. Livingstone, Whitman, Mass., who says: "The inclosed sketch is of a 6-inch Coes wrench which I have improved by drilling a 3-16-inch hole in the knurled thumb-piece. This



Wrench as Hand Vise

enables one to insert a punch or piece of rod in hole and so obtain a greater leverage. This makes a good hand vise with parallel jaws. By closing jaws together and drilling down and across between jaws with ⅛-inch drill, round pieces may be more securely held."

MELTING BRASS IN AN OIL FURNACE.

"For melting a good grade of metal for a fairly heavy class of work such as building locomotives, rotary oil furnaces are less expensive than crucibles," declares a correspondent of the Foundry, "but for a very light class of work, such as melting yellow brass, the crucible is best." Manufacturers of crucibles claim there is a great loss in shrinkage of metal when melting with oil. To sustain his statement as to the advantages of the oil furnace the writer makes the following comparison:

"In the foundry I am going to use for illustration they cast 3,000 pounds a day on an average, and up to August 1 used the crucible furnace. They used two sizes of pots, Nos. 200 and 150. Of the No. 200 size they used on an average, 12 a month at $10 apiece, making $120. Of the No. 150 pot, four a month at $7.50 apiece, or $30, making $150 for crucibles alone; for 3,000 pounds of brass it will take 2,250 pounds of coke at $5.25 a ton, which is $5.90 a day for coke; costing $153.40 a month for fuel with a loss of shrinkage of metal averaging 2¾ per cent. They melt all good brass of a mixture of 50 per cent new metal and 50 per cent of scrap. The new metal is copper 80, tin 10, lead 10, and small per cent of phosphorus. The scrap is all railroad scrap, running in weight from ½ pound to 30 pounds apiece. Ten days after the furnace was running the fireman charged 1,100 pounds of metal, 50 per cent new and 50 per cent scrap, and got 1,076 pounds of castings and sprues, making a loss of 2 2-11 per cent, and in the crucible 2¾ per cent of loss, a saving of loss in melting. To melt 3,000 pounds in the oil furnace at 2 gallons of oil to 100 pounds of metal, with oil at 3½ cents a gallon will cost $2.10, quite a saving over $5.90 for coke to melt the same amount of metal. The total cost of a month's run in which 78,000 pounds of metal was melted was as follows: When using the crucibles, $303.40, and when using the oil furnace, $54.60. The difference making a saving of $248.80 a month not figuring the cost of lining furnaces, either oil or crucible.

"This oil furnace has two chambers, and while melting in one side the heat has to pass through the other side to find an outlet, and by doing so heats the metal almost to a melting point; so that in melting the second heat on the other side the cost of oil is very small, as two gallons for a hundred pounds of metal is a high figure.

"The cost of the furnace is $950, all put in place and ready to melt, and the only extra cost is a small fan, say $1,000 all told. This company was using oil in their plant for other purposes, so all that was needed was to connect the pipes to their oil tank. If the oil tank had to be put in it would cost more. But to compare the two ways of melting, the furnace will pay for itself in less than four months, and besides it is not so hard on the melter, and does not keep the shop so warm. You can put your hand on the oil furnace when it is melting and not burn yourself."

PASTE FOR DRY BATTERY.

The following is from Bubier's Popular Electrician:

Plaster of paris, 1 pound; oxide of zinc, ¼ pound; saturated solution of chloride of zinc, enough to make a thick paste. Make a zinc box, putting your carbon element in the center, at the same time insulating the carbon from the bottom of the box with a piece of fiber. Fill the box with the paste and seal up tightly, insulating the carbon from the top of the box with fiber also. The zinc forms one pole and the carbon the other.

The most effective way of de-magnetizing a watch is to place it inside a coil of wire through which an alternating current is flowing. Hold the watch by the chain and twist it slowly, by turning the chain. After this treatment for four or five minutes, gradually withdraw the watch, still revolving it. A common method pursued in electric light stations is to lay the watch down on the sheet iron core of the transformer. A piece of wood should be placed under the watch to protect from injury by the heat.

CHASER FOR CUTTING THREADS.

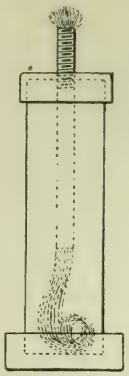
"Last week I made a chaser for cutting or recutting threads in the lathe, by hand. For 1-inch thread put a 1-inch pipe tap in the lathe and set the gears for 11½-inch thread. Then put the chaser in the tool rest and feed against the tap just a few times up and the tool is done. I have been a machinist 17 years but have not seen this method printed."—Contributed by I. H. Gingrich, 328 First St., Grand Rapids, Mich.

HEAVY SCREW DRIVERS.

The young mechanic is very apt to ruin one or two good screw drivers in trying to start set screws or screws that have rusted in. For this and similar work a specially heavy screw driver is made, the shank being square and strong. The operator can then put all the power he wishes on the wrench, without fear of twisting it or bending the blade.

HOW TO MAKE A TORCH OF PIPE.

A simple and inexpensive torch may be made of a short length of pipe. Select 1½-inch pipe for the purpose, and on the bottom screw a cast-iron cap, one which is heavy enough to form a base for the torch and hold it upright. Use a malleable iron cap for the top and before screwing it on tap a hole for ½-inch pipe 3 or 4 inches shorter than the body, and the screw-thread should be about 3 inches long on one end. Screw it through the cap from the bottom until it projects about 2½ inches, says the Engineer, and the torch will be complete.



A GOOD SOLDERING FLUID.

A correspondent in Bubier's Popular Electrician gives the following recipe:

Take a piece of scrap zinc or pure spelter, say about ¼ pound, and immerse it in a half-pint of muriatic acid. If the piece completely dissolves, add more zinc until the acid ceases to bubble and a piece of metal remains. Let this stand for a day and then carefully pour off the clear liquid, or filter it through a cone of blotting paper. Add a teaspoonful of sal-ammoniac, and when thoroughly dissolved, the solution is ready for use. Depending on the materials to be soldered, the quantity of sal-ammoniac can be reduced. Its presence makes soldering very easy, but, unless the parts are well heated so as to evaporate the salt, the joints may rust, and a poor electrical connection result. Some concerns put a few drops of glycerine in their soldering fluids.

TAKING OUT BRUISES IN FURNITURE.

If the bruise is very small all that is necessary is to soak it with warm water and apply a red-hot poker near the surface, keeping the spot continually wet until the bruise disappears, which will occur in a few moments.

For larger bruises or dents wet the part with warm water and double a piece of brown paper five or six times, soak it, lay on the bruise, and then apply on top of the wetted paper a hot flatiron until the moisture has all evaporated. Keep this process up until the surface is level.

ANGLING FOR A FOOT-VALVE.

A good tool for fishing up a broken foot-valve in a pump was contrived by a correspondent of Power. An impression of the valve, the construction of which no one knew, was first taken by means of a tomato can filled with bar soak, secured to the pump rod and lowered into the well until the open end of the can of soap rested on the foot-valve. When withdrawn it showed the imprint of a rubber valve tilted up at an angle.

The fishing tool was made of a strong wood screw fastened into the lower socket of the wooden rod by standing the screw on its head on the bottom of the socket and pouring babbitt metal around it, which was hammered down solid to keep the screw from turning. When lowered into the well a few turns of this tool sank the screw into the rubber and the valve was drawn up into view after which a new foot-valve was put on.

REMOVING LIME IN WATER JACKET.

The removal of lime incrustation is always a more or less difficult job. Muriatic acid, of course, cuts the lime and dissolves it, but it is liable to cut quite deep into the iron as well and leave it rusted, says Gas Power. A small amount of common washing soda used in water after you have washed out the acid will neutralize the acid, but you should be careful to wash the water containing the soda out, as soda remaining for any length of time will rust the pipes and connections, too. One of the most efficient methods that I have ever seen for removing scale from small automobile boilers was to use common crude oil mixed in with the water. The process is this: First disconnect your tank and drain all of the water out of the jacket, then pour in about a pint of crude oil in the jacket, then fill in with water until the oil shows at the top outlet of the jacket; shut off the circulation of water and run the engine, carefully watching it so that it does not become overheated. Then engine should be run until practically all the water in jacket boils away. As the water level goes down the oil follows and has a very considerable loosening action on the lime. The advantage of this method is that there is no risk of rusting, but there is some of overheating and the engine should be run at quite low speed in order to avoid this.

LIFE OF CAST-IRON PIPE.

It is extremely difficult to get any satisfactory estimate as to the average length of life of street mains. Practical men in the trade say that it is a question for the chemist, says Domestic Engineering. The chemical constituents of the soil and the likelihood of exposure to electrolysis have everything to do with the matter. Where garbage has been deposited, or the soil is alkaline from any cause, the pipe may not last more than three or four years. In a good natural clay or sandy soil pipes can easily last for twenty-five years. At the City Hall it is said that eighteen years is a fair estimate in Chicago, where conditions are most favorable.

A SIMPLE TEMPERING RECIPE.

Dissolve a small quantity of sal-ammoniac in water, make the metal red hot, dip it in the mixture and leave enough heat in metal to draw it back a bit. If left to cool in the liquid tools will show too hard.

TO REVIVE FROM SUFFOCATION.

By inhalation of poisonous gases, vapors, such as illuminating gas, charcoal vapor, gas in wells, sewer gas, coal gas, mine gas, etc.

Remove the patient to open air and send for a physician.

In rescuing, avoid risks. If in a room, open and close the door rapidly to fan and force air into it; break out windows. Do not take a light into a cellar, mine, well, apartment, or any place where gas has escaped. Tie a rope around the waist of rescurer; cover his mouth and nose with a handkerchief wet with vinegar and water.

Get the patient to fresh air. Dash cold water on his face and chest. Use artificial respiration the same as in drowning. Apply hot bottles to body; put mustard plasters to heart, soles of feet and wrists; when recovering, mild stimulants may be used.

HOW TO MAKE A GRAVEL ROOF.

There is no reason why a gravel roof should not be a good one, if only proper care and good materials are used in its construction; at least it should be good for the money expended on it when compared with the cost of tin, galvanized or copper roofs. Of course, a gravel roof is only suited for a low pitch or flat roof, as on a steep roof the gravel would eventually wash off and leave the paper or canvas exposed to the weather. Ordinary coal tar answers fairly well for a top coat before the gravel is spread on, if the roof is very flat. If the roof has a good pitch it is a good idea to mix 8 or 10 pounds of common rosin with the pitch while it is boiling, stirring the mass well with a stick before it is taken out of the boiler.

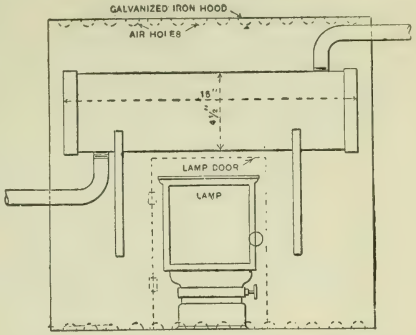
To prepare the roof before covering with tar after it is boarded tightly with matched stuff, the following rules should be observed: In all cases the grain of the roofing boards should run in the direction of the pitch—never across it—and all joints should be driven close and tight. The boards should be planed on the top side, and should be free from shakes or knot holes. Swab the whole roof over with a thick wash of Portland cement mixed with water to the consistency of thick paint. Let the roof dry for a few hours, then lay on a coat of good roofing paper—tarred paper preferred—having a lap of about one-third of the width of the paper. Over this give a thin coat of hot tar, in which ground asbestos, mica or Portland cement has been mixed, in the proportion of one bucketful of cement to four of hot pitch. Let stand until dry and hard. Over this lay another coat of roofing paper, and on this lay a thickness of rough sacking, which must be tacked down here and there with broad-headed tinned nails, such as tinsmiths use in roofing. On this sacking lay a thick coat of the tar while hot, and then sprinkle coarse sand and fine gravel on the hot tar and leave to harden. The tar must contain the proportion of asbestos, mica or cement as described in the foregoing.

Such a roof properly laid will last from seven to nine years, and may then be made good again by a generous coat of tar and fine gravel.

Our readers are urged to contribute to "Shop Notes" any kink they have worked out or may be using to advantage.

HOT WATER FOR BARBER SHOP.

A correspondent in the Metal Worker offers the following as a small heater which any mechanic can fix up. Make a small boiler of a piece of 4-inch wrought iron pipe, 15 inches long, with the ends capped and the inlet and outlets arranged as shown in the sketch. This is designed to lie horizontally and to have ½-inch holes drilled



Plan of Stove and Boiler Arrangement.

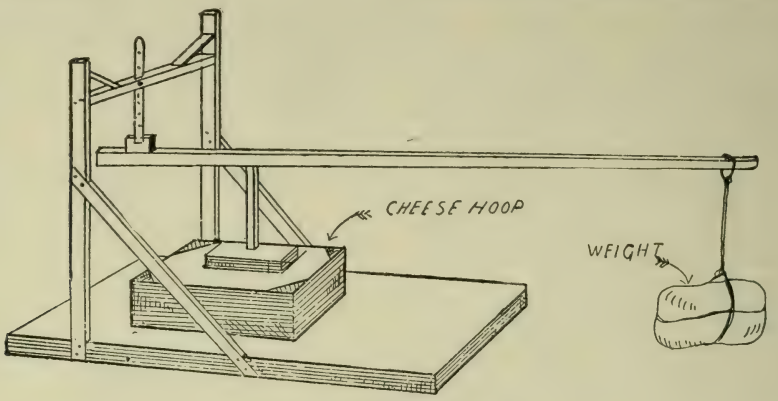
and threaded in each end, one on the top and the other on the bottom. This can be set up on a stand or brackets sufficiently high to allow a one-wick oil stove to be set under it. The stove and heater could be inclosed in a galvanized iron hood, with a few holes in the top and a few in the bottom to let in fresh air and allow the products of combustion to escape. The hood should have an opening large enough to allow the oil stove to be inserted and removed. This may be set under a sink, or any place where it will be out of sight. The space adjoining it may be protected by asbestos paper, if deemed necessary. If there is gas in the building, a gas flame can take the place of the oil stove.

HOW TO DARKEN OAK.

Oak may be immediately and easily darkened by laying on liquid ammonia evenly with a rag or brush. The effect produced is just the same as is produced naturally by age and the color will not fade. Bichromate of potash, dissolved in cold water and applied with a brush, is another method of deepening the color, or new oak may be brought to any shade, or nearly black, by the application of a decoction of green walnut shells. Be careful to apply each coat evenly.

HOW TO MAKE A CHEESE PRESS.

A cheese press may very easily be made at home and the skim milk used for making the cheese. If it has been the custom to feed skim milk to the hogs, the warm fresh whey may be given them instead, says Hoard's Diaryman.

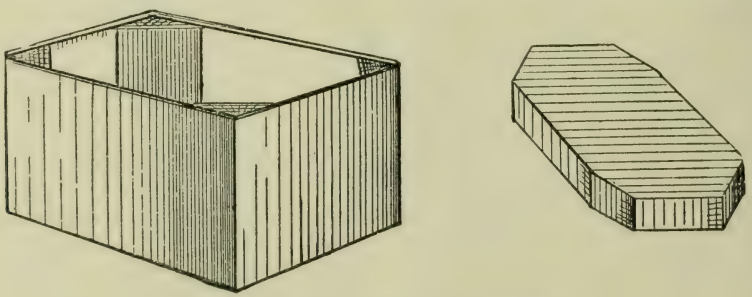


Home-Made Cheese Press

Make the bottom pieces of the press of wide plank and the standards of 2 x 4-inch wood—any wood that is tough and strong will do. The crosspiece between the standards should be very strong, also, so that it will bear the leverage. The part with the holes in should be of iron and adjusted by an iron pin. Weight the lever with a large stone.

Make the octagon-shaped cheese mould or hoop of inch boards, triangular shaped pieces being used to form the corners. The follower should be sawed from 2-inch plank to fit the hoop; make it deep and narrow so that the cheese may be pressed out in a good shape. The cheese hoop with its follower is placed on the bottom plank of the press and a square block of wood in which a short post is inserted is placed over the follower and makes the fulcrum for the lever.

In making cheese all milk containing from one to two per cent fat may be used. Besides the press a dairy thermometer, rennet, coloring and cheese cloth will be required. One hundred pounds of skim milk will make 7 or 7½ pounds of cheese. Fill the boiler with milk and place on the stove. Put the thermometer in the milk and slowly heat to 86 degrees. Now add two teaspoonfuls of rennet extract with water, about a half cupful, before adding to the milk. At the same time add a teaspoonful of coloring. Let the milk come to 90 degrees, take off the stove and cover with a cloth; in 15 or 20 minutes it should be sufficiently coagulated. When so, lift on the stove again, and with a table knife cut the curd in all directions so as to divide it into small cubes; heat slowly to 100 degrees, stirring occasionally to prevent the curd settling to the bottom and burning or over-heating. When a handful of curd upon being tightly squeezed until all the whey is out will fall apart easily, it is cooked



Octagon Cheese Hoop and Follower

enough. Take it off the stove again, cover as before and allow the curd to lie in the whey for a time. Lift the curd into a sink and let it drain. Work out the whey, grind the curd up with the hands, salt it with about 6 ounces of salt per 100 pounds of milk and work well. If not enough curd to fill the mould keep it in a temperature of about 60 degrees until next day, when more curd may be added.

After being in the press two hours, the cheese should be turned upside down, the cloths fixed nicely, and the pressure added as before; leave in press for two days; have the cheese well bandaged when put away to cure. A temperature of 60 to 70 degrees is best for curing the cheese, where it should be kept for three weeks, and turned daily.

HOW TO MAKE PHOSPHOR TIN.

The method for making phosphor tin which I use may not be applicable in a brass foundry doing a large business, but it is worth knowing, says a correspondent in the Foundry. This method must not be confounded with the fireworks producing method of using yellow phosphorus, with or without a coating of copper sulphate. I use red phosphorus, which can be obtained in the form of powder. It will not ignite below a temperature of 240 degrees Centigrade. The melting point of tin is about 230 degrees Centigrade, or ten degrees less than the ignition point of red phosphorus, and it is this difference of ten degrees which makes the method possible.

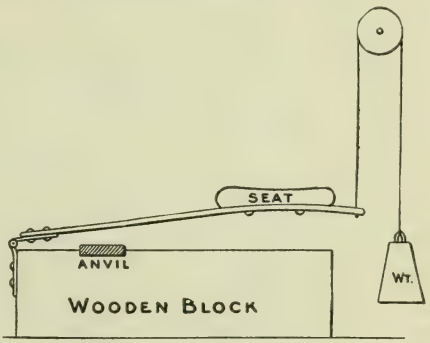
For every 28 pounds of tin, take 4 ounces of phosphorus and ram fairly hard into the bottom of a crucible of sufficient size to receive the required quantity of tin. The phosphorus should be covered with powdered charcoal and the crucible warmed before puting the phosphorus in. Melt the tin in another crucible, bearing in mind the fact that it must be just melted and not overheated, on account of the fact that there is only a ten degree leeway between the melting point of the tin and the ignition point of the phosphorus. Pour the tin into the crucible containing the phosphorus, and after stirring and allowing some time for mixing, place the crucible in the furnace and burn off the excess of phosphorus. Arsenic tin can be made in the same way.

All the articles in "Shop Notes" department are printed at end of year in book form. Price 50 cents.

HUMAN CLAMPS.

In the shops of the Pennsylvania lines at Pittsburg, Pa., a very ingenious clamp is used in dismounting broken air and steam hose, says Railway and Locomotive Engineering. The clamp is quite as practical as it is curious, however, and might readily be adapted to other forms of work.

It consists of a stout block of wood about 16 inches high placed on the ground and having an iron plate let into its upper side at a suitable point. The plate forms a sort of anvil. A piece of spring steel is hinged at one end of the block and the other end of the steel carries a seat, the whole being counterbalanced by a weight which hangs from a pulley on a post nearby.



Seat Clamp For Dismantling Hose

When the operator wishes to take off broken hose from a nipple which is to be used again, he lays it on the anvil, leaving the clevis projecting beyond the steel spring, and then he literally sits down on the whole job. His weight effectually clamps the piece of hose pipe in place, and holds it in a most convenient position for working. When he wishes to release the work, he eases up on his seat, and the counter weight on the post carries seat and spring up so that the hose is instantly freed. In fact, the act of standing up to reach another broken piece of hose lets the one which has been dismantled come out of the machine.

The device is very simple and as there is practically nothing about it to wear out, it has no maintenance charge. The heaviest man secures the best clamp on his work.

If Popular Mechanics has no representative in your shop write for particulars, and learn how you can earn money easily every month.

HOW TO MAKE A HANDY KEY-SEATING TOOL.

A correspondent of the American Machinist tells how he made a key-seating tool and 12 keyways in one and one-half hours. He says:

"The problem was to keyseat some gunmetal articles, and as the hole was ⅜ inch

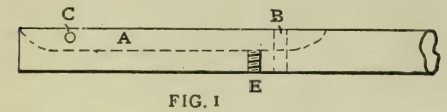


FIG. 1

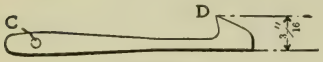


FIG. 2

A Keyseating Tool

diameter by 2 inches long, I thought it impracticable to chip or file them—the more so, as they had to slide on the shaft without much shake. This necessitated a smooth, straight keyway.

"I took a piece of ⅜-inch shaft about 12 inches long, milled a keyway (A) in it about 3 inches long, and inserted a tool shipped like Fig. 2. B is a ⅛-inch pin for a stop to take up thrust, C is a 1-16 pin holding tool in slot, D is the cutting edge.

"I then held the articles in the universal chuck of the lathe, the tool mounted in the tool-post of the lathe. I then pushed through, tightening ⅛-inch screw (E) each cut. The tool and twelve keyways complete took one and one-half hours."

HOW TO RECOGNIZE A GOOD QUALITY OF GLUE.

Break a cake of the glue into several pieces, either by striking it a blow with a hammer or by bending it. If the broken pieces have smooth, even edges, the glue is of poor quality. If the edges are very ragged, the quality is good. The more splinters at the broken edges the more the glue is to be depended upon and it will stand damp weather well.

A German chemist has invented a method of manufacturing fluid gas from the residuum of petroleum and heavy mineral oils. The inventor claims it can be manufactured cheaply where there is an abundance of petroleum and can be transported in cylinders. The gas makes a brilliant light for street lighting and is very difficult to explode.

PUTTING PLUGS IN WATER PIPES.

While making some changes in the water piping in a large building I ran across a job that I think worthy of mention, says a writer in Practical Engineer. The business of the company occupying the building necessitated the erection of a new building in the rear of the main building, and when the contractor was well along with the excavating work it was found that the city water pipes were much in the way, so much so that it was necessary to break and plug several joints.

I found that to do this would require four 8-inch plugs and two 10-inch plugs. As the piping was cast iron and the joints bell and spigot, considerable time was lost looking for special plugs. Only two plugs could be found, so I made the following suggestion: I had two blank flanges cut from 3-16-inch boiler plate the same diameter as the spigot end of the pipe, two 8-inch and two 10-inch. After hunting around the plant I found two specials, the running size being 8 inches and the side outlets 4 inches, which were broken at the 8-inch bell ends. Using a handle chisel, the spigot ends were cut off; the ends were 14 inches long. For the two 10-inch openings I had to cut the spigot end off of two lengths of 10-inch cast iron pipe. Making sure that the blank flanges were smooth, I put them into the bell of each opening and with the spigot end against that, and wedged the pipe firmly in the center of the bell, and then drove in about five strands of thoroughly twisted jute. After all the joints had been prepared in this manner I heated the lead and with a jointer on each connection the hot metal was poured in. When the metal had set it was driven up in each joint, and when the pressure was turned on the piping showed no signs of leaking.

REMOVING GLASS STOPPERS.

Glass stoppers sometimes occasion even more difficulty than corks in their removal. An almost infallible cure for a fixed stopper is to grasp the bottle in the left hand, and with the thumb press against the offending stopper, while with the right hand gently tap against this pressure, using the handle of a knife or other hard instrument. In this way gradually work round the stopper, which will quickly become loose enough to be extracted.

EMERGENCY ROPE TIRE FOR AUTOMOBILES.

Rubber tires are not always to be had when wanted, but a piece of rope is generally to be found at any farm house. The Automobile gives the following valuable instructions on making an emergency tire:

If a tire is injured on a run so that it cannot be repaired, and if a substitute is not available, a rope can be wound on the wheel rim and the car run slowly to the nearest repair station. Before applying the rope, the car must be jacked up and the tube and shoe removed from the rim. The clamps or lugs which help to hold the shoe in place are also removed. Procure a piece of rope, of such diameter that when wound on the rim it will project above the edge or clincher and thus protect it. The rope should be long enough to wind around the rim several times, so as to completely fill the space in the rim ordinarily occupied by the tire.

Before the rope is put on, a piece of wire or strong cord should be fastened securely to one end. The free end of this cord or wire is pushed through the valve hole in the rim and fastened to one of the spokes. After one of its ends is thus secured, the rope can be wound on the rim. Care should be taken that the rope is wound on as tightly as possible. To do this an assistant will be, usually, required, who should turn the wheel slowly while the rope is laid on under tension. The other end of the rope is now secured by means of a piece of wire or cord, passing through one of the clamp holes and fastened to a spoke, as already directed.

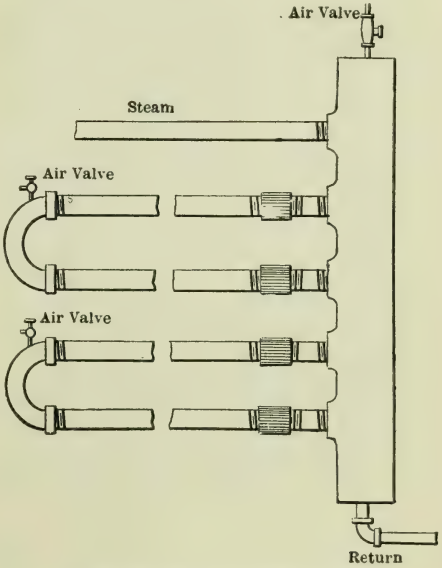
After the car has been lowered down and the jack taken away, the motor may be started and the car driven slowly to the nearest repair station. When driving a car having ropes on a wheel rim as described, great care is necessary. When passing over car or railroad tracks, or when passing over streets paved with stone blocks, the rim may be ruined, if the car is driven at any but the slowest speeds.

It is well to bear in mind that the wheel which has the rope on its rim has a smaller effective diameter than the other wheels, which have tires on. Consequently if either of the rear wheels are roped as described, the differential gear will function as long as the car is moving. For this reason the car should not be driven any great distance under these conditions, as excessive wear of the differential pinions would result.

Ropes on one of the front wheels will interfere with the operation of the car only very slightly, and it may therefore be driven for a greater distance without injury than if one of the rear wheels is roped. If there are any passengers it is well to arrange them so as to have as little weight on the disabled wheel as possible.

RE-ARRANGING HEATING COILS.

A steam heating coil consisting of a continuous coil of pipe around one side and on the end of a room, connected by return bends, which required 15 pounds of pressure to heat was changed by a correspondent of Power, who wished to use exhaust steam for heating so that the room could be heated nicely with less than two pounds back pressure on the exhaust.



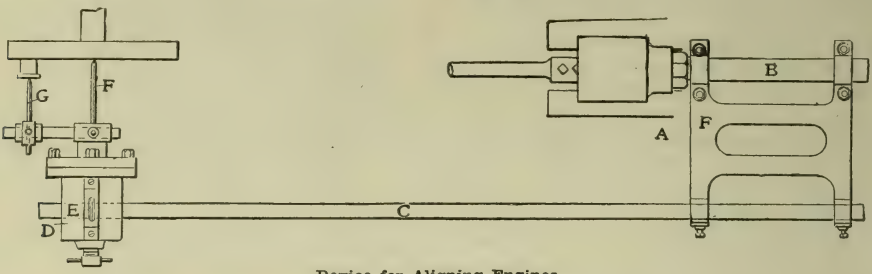
Re-Arrangement of Steam Coils

One day after the coils had frozen up he broke the return bends off at one end with a hammer and substituted a branch tee with right and left nipples and couplings to connect up as shown in the sketch. He put an air valve on the top of the tee and one on the end of each loop. The heat could then be controlled in each loop separately by means of the air valve on that loop, and the whole arrangement worked admirably.

Engineers are scarce in the United States navy and Rear Admiral Charles W. Rae, engineer-in-chief of the bureau of steam engineering, is urging special legislation by Congress with a view to increasing the number of naval officers available for engineering duties.

A SIMPLE INSTRUMENT FOR ALIGNING ENGINES.

An instrument for aligning engines which is simple in construction and particularly helpful in engine-rooms containing a number of engines on which adjustments are frequently made is described by a correspondent of Power who says he patented it years ago.



Device for Aligning Engines.

It consists of a frame, A (see sketch), which is attached to the piston rod of the engine, B, after the connecting rod has been disconnected from the crank-pin. The rod, or preferably a tube, C, is adjusted in the frame, A, and is perfectly parallel to the piston rod, B. This rod, which lies in the same horizontal plane as the piston rod, extends a few inches beyond the center of the crankshaft, forming what is a parallel extension of the piston rod, A. On the end of the rod, C, is carried the sliding adjustable head, D, which is fitted with a small level on the top, E, and two adjustable pointers, F, and G; F is centered at the center of the crank-shaft and G at the center of the crank-pin, and if the crank-shaft is true when it is rotated, the ends of these pointers will remain at the same parallel distance from the rod, C. If the shaft is not at right angles to the piston rod, on rotating it and the pointer, G, the error may be easily measured by observing the amount that the pointer, G, slides in or out of its socket in order to remain in contact with the end of the crank-pin. The slightest variation of the shaft from a right angle or a level position will be shown by the instrument, which may be used without a great amount of labor or loss of time.

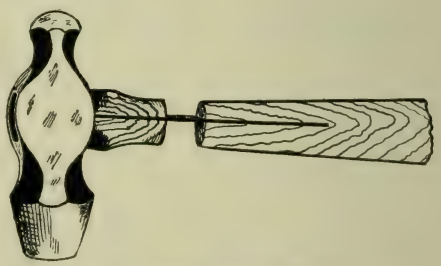
BULGING PUTTY.

In a paper read before the Master Car and Locomotive Painters, at Atlantic City, B. E. Miller reported:

"Bulging of putty is probably caused by the expansion and contraction of the wood during damp weather. As the moisture is evaporated the surface shrinks, decreasing the size of the nail hole. Ninety per cent of the effect is from this cause and 10 per cent is from the expansion and contraction of the nail and the effort of the wood fiber to straighten. It was demonstrated to the committee that where a small nail was used the bulging amounted to but little. The bulging increased with the size of the nail head and the depth of set. It was recommended to use none but seasoned lumber; use small-headed nails as possible; set them not more than 1-16 of an inch below the surface; thoroughly prime and second coat all depressions, including heads of nails and screws."

IMPROVING A HAMMER HANDLE.

When putting a new handle in a hammer for use at the anvil the following little wrinkle, given by a correspondent of the American Blacksmith will be found to greatly improve it.



An Improved Hammer Handle.

Cut a ¾-inch piece out of the handle 2 inches from the hammer head. Slot each end of the cut to receive a piece of spring steel 3/32-inch thick and as wide as the handle. Fasten the steel with rivets. The extra work requires but a few minutes longer, and well pays for the trouble.

THAWING SERVICE PIPES BY ELECTRICITY.

A Transformer Specially For This Work

The approved, rapid and economical method of thawing frozen water and gas pipes is by electricity. A new transformer for this especial purpose and designed to work on alternating circuits of from 2,000 to 2,300 volts, is the latest addition to the electrical apparatus. The transformer operates by means of an adjustable core or flux shunt controlled by a hand wheel and locking device.

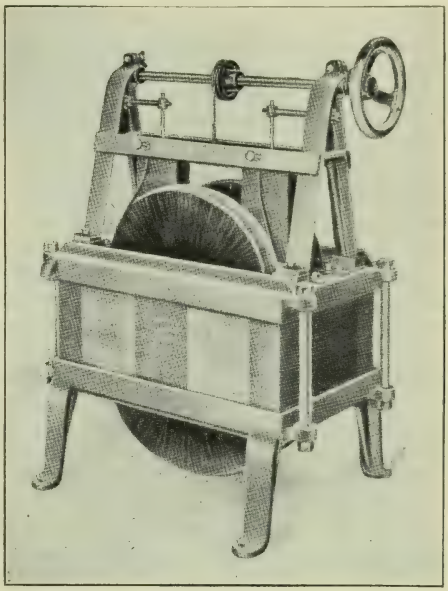
The transformer after being located close to the frozen pipe should have the flux shunt core dropped to its lowest position, the secondary connected to the water pipe and the primary connected to the line. After closing the primary switch the shunt should be raised by means of the operating handle until a sufficient voltage and current are obtained for the particular pipe under treatment. The operating handle should then be securely clamped by means of thumb screws provided for this purpose. After the pipe is completely thawed, the shunt should again be secured at its lowest position ready for the next treatment. In thawing street mains two adjoining hydrants can conveniently be used as terminals. Service pipes can be thawed out by using as terminals a house faucet and the nearest hydrant, the house faucet and the service pipe, or a faucet in a neighboring house.

In every case special precaution must be taken to make good connections, otherwise the water faucets, hydrants, pipes, etc., used for terminals will be burned and disfigured by the heavy current used.

No positive rule is given as to the exact length of time required in any particular case owing to the widely varying conditions, but the following table compiled from records made last winter furnish a fair basis of average conditions:

Size Pipe	Length	Volts	Amps.	Time Required to Thaw
¾″	40 ft.	50	300	8 min
¾″	100 "	55	135	10 "
¾″	250 "	50	400	20 "
1″	250 "	50	500	20 "
1″	700 "	55	175	5 hrs.
4″	1300 "	55	260	3 "
10″	800 "	70	400	2 "

The manager of the Public Service Corporation of New Jersey, which has a record of 2,963 services thawed out, states: "The first wagon was fitted up with a considerable amount of apparatus for making calculations, but after a very brief experience all the instruments were discarded and the operator simply gauged his work by the manner in which the water boiled in the barrel on the wagon, which was used as a resistance. Additional wagons were fitted up in this manner and the work carried on



Transformer For Thawing Out Pipes

to the extent of our ability to spare men and wagons from other work. Most of the wagons contained a 300-light transformer wired up to a rough wooden rack, with primary fuse boxes on the side, and sufficent length of wire to reach an ordinary overhead circuit, the custom being to stand the wagon alongside the pole nearest the building where the pipes were to be thawed out. On the secondary side a heavy knife switch properly fused was fastened in the bottom of the wagon, and two coils of heavy wire mounted on reels were also provided.

"In the case of a single building, the method of procedure was usually to connect the primary leads to the overhead circuit, insert the primary fuses, run out the two heavy wires from the reels to the desired

length; one end being connected usually through the cellar window to the water pipe, as near the cellar wall as possible, the other end being connected to the nearest hydrant or curb box, preferably on the opposite side of the street. The object was to allow treatment of the pipe at any point between the cellar wall and the street main, as there was no way of determining the exact point of interruption.

"When the pipes of two or more adjacent buildings were to be treated, the water services were simply connected in series, and as a matter of fact it was found to be just as easy to thaw several houses and took no more time than it did for one. As a matter of experiment we tried grouping buildings, to see what the result would be, and the largest number we were able to find in one location, which consisted of a row of small tenements, fourteen in number, were thawed out as easily as a smaller number, although the time required was somewhat longer.

"By having sufficiently long secondary leads, we also found it more convenient to extend the secondary than to move the wagon, and in one instance we thawed out about thirty pipes without moving the wagon. The length of wire used in this case, however, was about 500 feet. Charges for the service varied from $4 to $15, and was very much less than the cost of tearing up the pavement would have been. In one case a 6-inch main was thawed out simply as a matter of experiment, the time required being about three hours. The number of services that can be handled by one outfit in a day depends entirely on local conditions of poles, wires and location of service. Our outfits consist of two men each with a horse and wagon, and each outfit averages all the way from 10 to 200 pipes thawed out per working day."

Transformers are also made to work on circuits of 500 volts.

COVERING FOR OVERHEAD STEAM PIPES.

A pipe for overhead steam pipes that is advocated by Mr. Robert Watt in a contribution to the question box of the Ohio Gas Light Association is described in the "American Gas Light Journal." The pipe is enclosed within a molded covering and wrapped in canvas, and the canvas is painted with two coats of tar boiled down to the consistency of soft pitch, having a little slate flour, slaked lime or hydraulic cement added to it. It is applied with a brush, the second coat two or three days after the first.

CLEANING BOILER TUBES.

In a certain city there are two breweries operated by one company each brewery having a separate steam plant says a correspondent in the National Engineer. The engineer of one of the plants insists that the proper way to keep his boiler tubes clean is to use a steam cleaner frequently and not use a scraper until the boiler is laid off, or, in this case, about every two weeks. In defense of this method he states that the boiler and inner setting are exposed to the surrounding atmosphere for a much shorter period of time than would be possible if a scraper alone were employed.

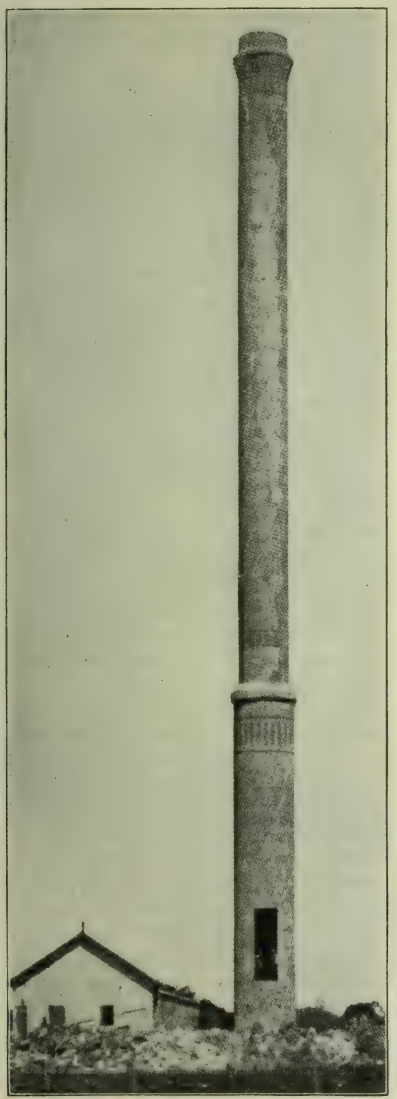
At the other plant the tubes are scraped each day, the engineer there claiming that using a steam cleaner serves to accumulate soot in the tubes, whereas the scraper effectually removes it.

In my opinion both methods are right under certain conditions. One objection to the steam cleaning method, as found in average use, is that the steam used is heavily saturated with water, and in passing through the tube part of it condenses, causing an immediate pasty deposit in the tube, which shortly after hardens and perceptibly affects the transfer of heat to the water in the boiler. In such cases, unless a scraper is used frequently, this deposit accumulates to an extent that calls for a considerable amount of coal in excess of what would otherwise be necessary. Just how often the scraper should be used depends somewhat on the conditions the boiler is operated under. It is safe to say, however, that reliance should not be placed exclusively on steam cleaners. If it comes to a choice between the two methods, the scraper will be found to keep the tubes cleaner than the steam blower.

More natural gas was produced last year than ever before, and was valued at $35,815,000. Ninety-four per cent was produced in Pennsylvania, West Virginia, Ohio and Indiana. The consumers, manufacturers and individuals totaled 634,269. The United States produced 99 1-3 per cent of the entire world's production of natural gas.

LARGEST STEEL-CONCRETE CHIMNEY IN THE WORLD.

The largest steel-concrete chimney in the world was recently erected at Bellevue, Mich. It is about 182 feet high with a 22-



Concrete Stack

foot square base built in solid rock 4 feet in the ground, and having 108 steel bars imbedded in it. The chimney consists of an inner and outer shell, 8 and 4 inches thick, respectively, to a height of 60 feet, where they join, tapering from there on from 8 to 5 inches in thickness. It is a single piece from top to bottom and weighs with its base, 390 tons, 25,000 pounds of which is steel. Work was carried on from the inside at the rate of six feet per day.

TO LOOSEN RUSTY SCREW.

One of the simplest and readiest ways of loosening a rusted screw is simply to apply heat to the head of the screw. A small bar or rod of iron, flat at the end, if reddened in the fire and applied for two or three minutes to the head of a rusty screw, will, as soon as it heats the screw, render its withdrawal as easy with the screwdriver as if it were only a recently inserted screw. This is not particularly novel, but is worth knowing.

HOW TO SOFTEN PUTTY.

Putty which has become hardened by exposure, as around window sash, may be softened and readily removed by the use of the following mixture:

Slake three pounds of quickstone lime in water and add one pound of pearlash, making the whole of about the consistency of paint. Apply to both sides the glass and let it remain for 12 hours. At the end of that time the putty will be sufficiently soft so the glass can be lifted out of the frame.

HOW TO CLEAN POLISHED WOOD.

An encaustic composed of wax, sal soda and a good soap is excellent for cleaning and polishing at the same time. Shave the wax and the soap and dissolve them in boiling water; stir frequently and add the soda. When the wax and soap are thoroughly dissolved place the mixture in a vessel which can be closely covered and stir constantly till cool.

This mixture will remove ink from polished surfaces and may be satisfactorily applied to marbles, bricks, furniture, tiles and floors.

A car door fell from a freight train on the Southern Ry. so that it rested on both rails. The locomotive of a passenger struck it and the locomotive and tender were thrown down an embankment, killing the engineer, fireman and a flagman.

WORN VALVE GEAR AND HOW TO DEAL WITH IT.

Faulty action of the exhaust valves due to wear in the valve actuating mechanism is the cause ascribed by the Automobile of motors missing and not giving off power. In an excellent article on worn valve gear that paper further states:

The rollers, or shoes, which ride on the cams of the half-time shaft or the cams themselves may wear, owing to defective lubrication, or to the material of which they are made being too soft. If the amount of wear is, say, one-eighth of an inch, it is clear that the valve will open just this much too late, and close this much too early.

Back pressure will be caused by late opening, particularly at high speeds, and the burned gases will be retained in the cylinder by early closing, and will be compressed toward the end of the exhaust stroke. When the inlet valve opens, therefore, these burned gases, which are then under pressure, will rush out into the inlet pipe, and displace a portion of the incoming charge. Now the piston goes out on the suction stroke, and as the inlet pipe is full of exhaust gas, the fresh gas will not reach the cylinder until the piston has moved out a considerable percentage of its stroke. Consequently the volume of the aspirated charge will be less, and the percentage of burned gas to fresh, or explosive, gas will be greater. This will cause weak explosions and loss of power.

A little consideration will show that if the exhaust valves act as described, it will be almost impossible to throttle the motor, so as to make it run slowly. When the motor is throttled very much only a small quantity of explosive gas is taken in during each suction stroke. There is, as just shown, a relatively large volume of burned gas in the cylinder and passages. This burned gas may dilute the fresh gas to such an extent as to render the resulting mixture non-explosive.

When there is a greater distance between the "push-rod" and valve stem than 1-16 inch the valve actuating gear should be taken apart and refitted. More clearance must be allowed between the rod and valve stem when the latter is long than when it is short. The reason is, that a long valve stem lengthens more on being heated than a short stem. For this reason before testing the clearance between the stems and rods, one should make sure that the motor is thoroughly heated by running it for ten or fifteen minutes. This run ought to get the valve stems up to working temperature.

When fitting a new exhaust valve—especially if it has a long stem, and everything cold—be careful not to make this clearance too little. If too little clearance is allowed when the parts are cold, the expansion due to the working heat may be sufficient to lengthen the valve stem so much that it will rest on the end of the push rod, and so prevent the valve from seating fully. This will, of course, result in great loss of power also.

Often a motor will have good compression when cold, or slightly heated, and have next to none at all after it has run for some time. When a motor acts in this way, the trouble is usually due to leakage past the valves on account of the small amount of clearance between the valve stems and the push-rods. When the stems and valves are cold, the latter seat properly, but when the stems are heated, and of course expanded, the valves are prevented from seating by the stems resting on the push-rods.

Valve seats which are pitted badly are usually faced off. So much metal may be taken off in doing this that the stem of the valve—when the latter rests on the re-made valve—will touch the push-rod. After valves have been ground in a great deal, or after they have been faced off, the stems may also strike the push-rods. The action of mechanically operated inlet valves will be affected by wear in the mechanism, the same as exhaust valves.

Inasmuch as the springs on the inlet valves are usually weaker than on the exhaust valves, the wear on the parts which move them will not be so great. Another reason why the wear is less is that there is no pressure on the inlet valves at the instant when they are lifted, while the exhaust valves may have forty or more pounds pressure to the square inch on them at this moment.

Inlet valves do not get nearly as hot, and consequently do not expand as much as exhaust valves. For this reason less clearance should be allowed between the stems and push-rods than would be allowed between the stems and push-rods of exhaust valves.

The remarks about facing off the seats of valves and grinding in of exhaust valves apply to inlet valves also.

ELECTROGRAPHY: A COMPANION TO PHOTOGRAPHY.

[Excerpts from an article in London Technics, by Prof Chas. R. Darling, Demonstrator in Electrical Engineering Guilds Technical College, Finsbury.]

The term "electrography" is intended to embrace all the methods whereby, on passing a current of electricity through a suitable medium, images of the anode or kathode may be obtained either directly or by "development." The name was suggested by the analogies to photography presented by the processes, the difference consisting in the use of electricity instead of light to produce the effects.

A simple and convenient method of procuring these images or "electrographs" is by the use of the apparatus illustrated in Fig. 1. It consists of a sheet of metal A (preferably zinc or copper), on the top of which is placed an impression-pad B, consisting of a few sheets of damp blotting-paper superposed. The medium in which the images are to be obtained consists of a sheet of ordinary white paper C, damped with water or a suitable solution, according to the effect desired, as will be described later. One terminal of a battery is connected with the zinc plate, the other terminal being pressed on a metallic substance D (which may suitably consist of a coin, or small metallic block as used by printers), thereby completing the circuit through the pad and paper. Good results may be obtained by using a battery of six small accumulators,

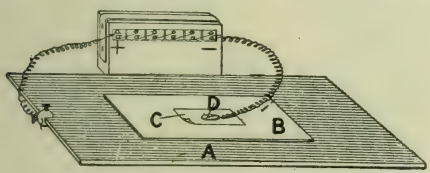


FIG. 1.
APPARATUS FOR OBTAINING ELECTROGRAPHS.

or six bichromate cells in series; whilst for quicker results wires from 100 volt mains (direct current) may be used. If arranged as shown in the figure, the coin being connected to the negative end of the battery, the direction of the current will be from the plate A (anode), to the coin D (kathode), through the pad and sheet of paper; to use the coin as anode it is only necessary to reverse the connections.

If, now, the sheet of paper C has been prepared by soaking in water and pressing out the superfluous moisture between the folds of blotting-paper—the pad having been similarly prepared—and a current of electricity be passed by pressing the negative terminal on the coin D for a few seconds, it will be found, on raising the coin, that no visible effect, other than that due to mechanical impression, is observable on the paper beneath. But if now the paper be

FIG. 2.—ELECTROGRAPHS OF COINS. THE LETTERING AND PATTERN ARE REVERSED, FORMING A "NEGATIVE."

treated in turn with silver nitrate solution and hydro-quinone, a clear black image of the coin is obtained. Any photographic developer other than hydro-quinone will produce the effect, and may be applied either before or after the treatment with silver nitrate. Nor is it necessary to "develop" the image immediately after performing the experiment; the paper may be kept for months, and will still be found capable of yielding the picture of the coin. This method of producing a picture differs from photography in so far as the paper is sensitised after exposure to electricity, instead of before exposure, as in photography. Fig. 2 is a reproduction of electrographs obtained in this manner. The lettering on the coins is, of course, reversed in the electrograph; but by employing a fusible metal mould of the coin as kathode, the ordinary appearance is presented.

It cannot be said that any completely satisfactory explanation of the electrical latent image has yet been given.

MECHANICS FOR YOUNG AMERICA

HOW TO MAKE "ANTIQUE" CLOCKS FROM UP-TO-DATE MATERIALS.

Ten years ago the antique clock was the only kind wanted, and it was of no value unless there were evidences of cobwebs and ages about it. The genuine old-timer

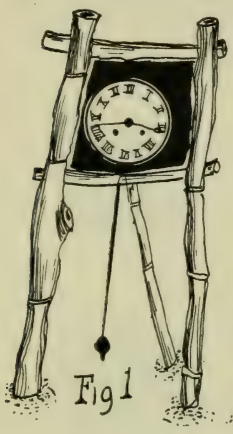


Fig 1

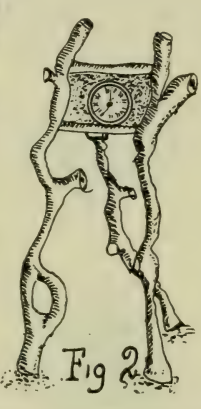


Fig 2

was the only kind desired. There were men in the junk business and men in the antique furniture business who made a specialty of buying the old clocks from the remote farming districts, or wherever any one had an old clock for sale. The clocks of our great grandfathers were in demand at good and remunerative prices to the original owners. Many were loth to part with the heirlooms, but the dazzling prices offered caused many of the people to sacrifice the timepieces. These good old days passed away some years since, and today the modern wood-worker and cabinet-maker supplies the deficiency by putting on the market some home-made, up-to-date forms of "antique" clocks that are far cheaper, more attractive and useful than the old styles.

The first innovation occurred when the antique furniture men began employing cabinet-makers to manufacture fraudulent old clocks. Men who could produce imitations closely, and then apply the proper stains for making the materials appear aged, were in request. These men manufactured numbers of the "copy" clocks, and for a time the sale was active. Then people suspected the genuineness of the undersold clocks, and discovered the fraud. The papers published articles about the fraudulant antiques, and the people no longer were deceived. But the advent of these "built-up" antiques, or "made-to-order" antiques, led to the manufacture of the rustic wooden clocks we are about to describe. The makers of clocks and novel effects in furniture began to produce clocks entirely new, and sold as new, but constructed on the lines of the old-fashioned corner piece of the farmhouse of a century ago. These clocks sold wonderfully well at good prices to the makers, and the demand commenced.

The cheapest and simplest constructed clocks are of the pine and rustic woods order, in which a framework is erected, a base or foundation for the clock fixed thereon, and the affair finished. Clocks of this order can be turned out at ridiculously low prices. Some sell for little over a dollar each, aside from the cost of the clock. The clock proper is usually a separate portion,

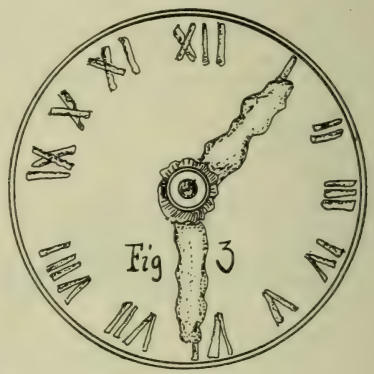


Fig 3

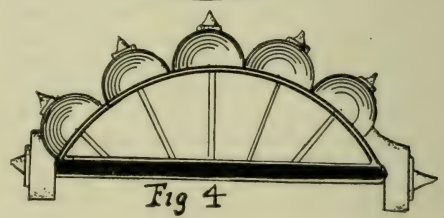


Fig 4

often not fixed to the framework until the entire combination is sold. Some of the unfinished pine clock frames are unique and rustic and appropriate for use in the summer homes. Figure 1 is a sketch of one of the cheaper forms of clocks of this style.

in which the framework is made from sections of bamboo, the joints being made with pins and wiring. The bamboo surfaces are merely rubbed with polishing compositions until a gloss is obtained. When well treated, the gloss retains its glaze and finish for a long time.

The manufacturer of the clock of this description usually makes a number of the rustic frames at the same time, say a dozen. These he erects and then places his order with a clock-maker for the clock faces, works and hands. The pendulums are likewise supplied by the clock-maker. The maker of the wooden clock portion knows little concerning the mechanism of the metallic parts of the clock, and therefore he obtains the clocks in running order and prepared for placing in position in the clock frame. Figure 2 is one of the rustic styles frequently seen in the clock-maker's works for service on porches, or for the house, if so desired. These clocks are made with frames constructed entirely from woods with the bark still on, and the effect is very pleasing. Goodly numbers of this pattern sell. The values run low, and for two or three dollars, counting expense of frame only, a very good outfit can be secured. The cost of the clock, of course, varies with what is desired. Dollar clocks may be fixed in the frame without pendulums and a good effect obtained.

When people purchase the big corner clocks for the hallway or the studio, they like to have something special in the line of faces and hands. Figure 3 is a sketch of one selection. The faces of the clocks are usually decorated in some way and are specially designed for the service they are intended for. The hands likewise are often mounted or ornamented.

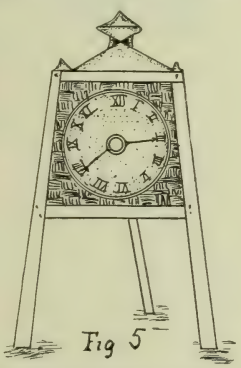


Fig 5

The crown work of the modern antique design in clocks forms another feature of interest. The crowns, as a rule, are separate portions, and since the opening of the "new" old clock industry in the country one is able to find men who make a specialty of the different parts of the clocks. In one city where there were several "old clock" manufacturers and designers one man is devoting his energies and ingenuity

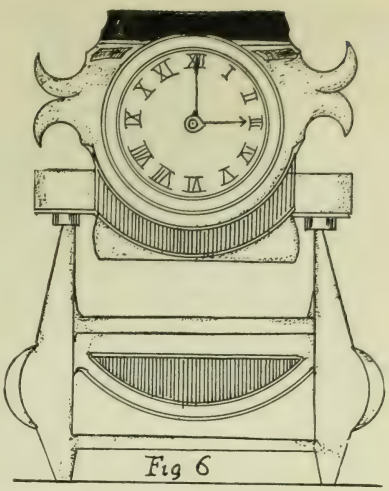


Fig 6

to the designing of clock crowns. Figure 4 is a drawing of one of his crowns. He makes only the crown portion, and this is for fitting over the top of the clock disk, and attached to the clock base. The crown usually has in it some artistic wood engraving and is otherwise decorated to assist in developing the idea of the artist.

The modern maker of the antique clock is capable of grinding out clocks for the chimney corner at rates astonishingly low, providing the customer furnishes the clock proper for insertion in the wood work. On the other hand, if one desires elaborateness, he may get it to the extent of his purse. If he desires to have his clock rendered "old" by treating with chemicals that age the woods and deceive people, he may have it done at a cost of a few dollars. It is pleasing to relate, however, that nearly every old clock-maker states that as a rule the buyers purchase the clocks simply because of their novel appearance, and intend to ornament their homes as such, without any intent at making their guests believe that the clock is an "antique" with a "history." One of the clocks of the more expensive order is shown in Fig. 5.

During the past few years the "old" clock-makers have had demands from advertisers for the service of imitation clocks for placing in railway stations, hotel offices, etc., to advertise products of big firms. The advertising wood clock is usually built up on elaborate lines, as suggested in Fig. 6, and the advertising material is marked thereupon. The advertising is usually made in plain letters. Some of these clocks are being made up to use in

connection with the penny-in-the-slot machines. The clocks can be made to look well and attractive for any place, and as they are usually freely ornamented, they are really part of the furnishings.

One of the best lines of patronage these manufacturers have is from the raffling off of goods at the church fairs, in stores and other places. Often there is a system of "guessing" of numbers and the right number wins, etc. The clocks are conspicuous, and can be liberally advertised in a store or other place where it is desired that the raffle take place. In some of the cabinet-makers' places men are employed at odd times on this line of work. Whenever regular work runs slow, the extra time is converted into money by making the clocks and a considerable profit is derived from the work.

LETTERING A CLOCK DIAL.

Painting Roman characters on a clock dial is not such a difficult task as might at first be imagined. In fact, if one has a set of drawing instruments and properly proportions the letters, it is really very simple.

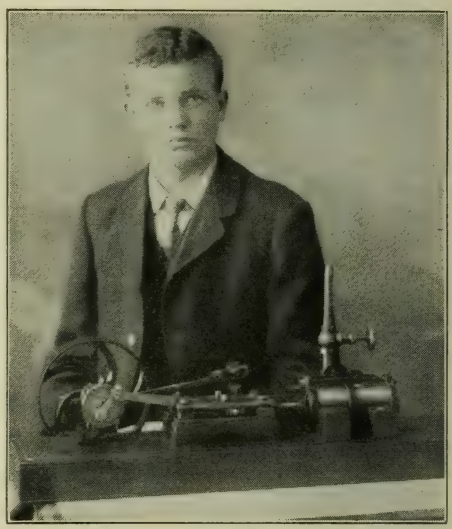
The letters should be proportioned as follows: The breadth of an "I" and a space should equal one-half the breadth of an "X," that is, if the "X" is one-half inch broad, the "I" will be three-sixteenths inch broad and the space between letters one-sixteenth inch, thus making the "I" plus one space equal to one-quarter inch or half the breadth of an "X." The "V's" should be the same breadth as the "X's." After the letters have been laid off in pencil, outline them with a ruling pen and fill in with a small camel's hair brush, using gloss black paint thinned to the proper consistency to work well in the ruling pen. Using the ruling pen to outline the letters gives sharp straight edges which would be impossible with a brush in the hands of an inexperienced person.—Contributed by S. L. Hatfield, Wagoner, Ind. Ter.

FOCUSING SCREENS.

To make a focusing screen, superior to the finest that can be bought, fix a dry plate, then flood it with a 10 per cent solution of chlorid of barium, and follow this with a 10 per cent solution of chlorid of magnesium. Allow to dry, and a perfect focusing screen results, says Photo-Beacon.

HOW A BOY BUILT A STEAM ENGINE, WITH FEW TOOLS.

A boy who possesses natural mechanical and inventive genius can build himself a steam engine even though he does not have access to a small machine shop and though his materials be crude. Howard Burr of Leon, O., built for himself a one-half horsepower engine which will operate a sewing machine. He cut his own patterns, then molded the various parts in sand. The castings were made of babbitt metal, which he heated in a ladle in a cook stove. The engine works perfectly. It is shown in the



Howard Burr and His Engine

photograph together with its inventor.

In response to our inquiry the young engine builder replies as follows: "I have your letter asking for a description of how I built my steam engine. The castings are made of babbitt metal; such parts as the connecting rod, eccentric rod, and slide bars were sawed out of iron and brass. The cylinder is brass. The piston was made by casting solid and then turning a deep groove in it and then made steam tight by winding with packing. The valve seat and valve was made true and steam tight by grinding with emery and oil. I built the engine with tools that may be found about any house, and worked at it mostly at night. One engine the cylinder is 2 x 2 in.; the smaller one has a cylinder 1¼ x 1¾ in. Patience and keeping at it is more than anything else." HOWARD BURR.

A Full Dollar's Worth Free

I will gladly give any sick one a full dollar's worth of my remedy to test. I ask no deposit—no promise. There is nothing to pay, either now or later. The dollar bottle is free.

I want no reference—no security. The poor have the same opportunity as the rich. The very sick, the slightly ill, invalids of years, and men and women whose only trouble is an occasional "dull day"—to one and all I say "Merely write and ask." I will send you an order on your druggist. He will give you free, the full dollar package.

My offer is as broad as humanity itself. For sickness knows no distinction in its ravages. And the restless patient on a downy couch is no more welcome than the wasting sufferer who frets through the lagging hours in a dismal hovel.

I want EVERYone, EVERYwhere to test my remedy.

There is no mystery—no miracle. I can explain my treatment to you as easily as I can tell you why cold freezes water and why heat melts ice. Nor do I claim a discovery. For every detail of my treatment is based on truths so fundamental that none can deny them. And every ingredient of my medicine is as old as the hills it grows on. I simply applied the truths and combined the ingredients into a remedy that is practically certain. The paragraphs below will show you the reason why.

In eighty thousand communities—in more than a million homes—Dr. Shoop's Restorative is known. There are those all around you—your friends and neighbors, perhaps—whose suffering it has relieved. There is not a physician anywhere who dares tell you I am wrong in the new medical principles which I apply. And for six solid years my remedy has stood the severest test a medicine was ever put to—I have said "If it fails it is free"—and it has never failed where there was a possible chance for it to succeed.

But this mountain of evidence is of no avail to those who shut their eyes and doze away in doubt. For doubt is harder to overcome than disease. I cannot cure those who lack the faith to try.

So now I have made this offer. I disregard the evidence. I lay aside the fact that mine is the largest medical practice in the world, and come to you as a stranger. I ask you to believe not one word that I say till you have proven it for yourself. I offer to give you outright a full dollar's worth of Dr. Shoop's Restorative. No one else has ever tried so hard to remove every possible excuse for doubt. It is the utmost my unbounded confidence can suggest. Its open and frank and fair. It is the supreme test of my limitless belief.

Inside Nerves!

Only one out of every 98 has perfect health. Of the 97, sick ones, some are bed-ridden, some are half sick, and some are only dull and listless. But most of the sickness comes from a common cause. The nerves are weak. Not the nerves you ordinarily think about—not the nerves that govern your movements and your thoughts.

But the nerves that, unguided and unknown, night and day, keep your heart in motion—control your digestive apparatus—regulate your liver—operate your kidneys.

These are the nerves that wear out and break down.

It does no good to treat the ailing organ—the irregular heart—the disordered liver—the rebellious stomach—the deranged kidneys. They are not to blame. But go back to the nerves that control them. There you will find the seat of the trouble.

There is nothing new about this—nothing any physician would dispute. But it remained for Dr. Shoop to apply this knowledge—to put it to practical use. Dr. Shoop's Restorative is the result of a quarter century of endeavor along this very line. It does not dose the organ or deaden the pain—but it does go at once to the nerve—the inside nerve—the power nerve—and builds it up, and strengthens it and makes it well.

Many Ailments-One Cure

I have called these the inside nerves for simplicity's sake. Their usual name is the "sympathetic" nerves. Physicians call them by this name because each is in close sympathy with the others. The result is that when one branch is allowed to become impaired, the others weaken. That is why one kind of sickness leads into another. That is why cases become "complicated." For this delicate nerve is the most sensitive part of the human system.

Does this not explain to you some of the uncertainties of medicine—is not a good reason to your mind why other kinds of treatment may have failed?

Don't you see that THIS is NEW in medicine? That this is NOT the mere patchwork of a stimulant—the mere soothing of a narcotic? Don't you see that it goes right to the root of the trouble and eradicates the cause?

But I do not ask you to take a single statement of mine—I do not ask you to believe a word I say until you have tried my medicine in your own home at my expense absolutely. Could I offer you a full dollar's worth free if there were any misrepresentation? Could I let you go to your druggist—whom you know—and pick out any bottle he has on his shelves of my medicine were it not UNIFORMLY helpful? Could I AFFORD to do this if I were not reasonably SURE that my medicine will help you?

Simply Write Me

The first free bottle may be enough to effect a cure—but I do not promise that. Nor do I fear a loss of possible profiit if it does. For such a test will surely convince the cured one beyond doubt, or disbelief, that every word I say is true.

The offer is open to everyone, everywhere. But you must write ME for the free dollar bottle order. All druggists do not grant the test. I will then direct you to one that does. He will pass it down to you from his stock as freely as though your dollar laid before him. Write for the order today. The offer may not remain open. I will send you the book you ask for beside. It is free. It will help you to understand your case. What more can I do to convince you of my interest—of my sincerity?

For a free order for a full dollar bottle address Dr. Shoop, Box 3353 Racine, Wis. State which book you want.

- Book 1 on Dyspepsia.
- Book 2 on the Heart.
- Book 3 on the Kidneys.
- Book 4 for Women.
- Book 5 for Men.
- Book 6 on Rheumatism.

Mild cases, are often cured with one or two bottles. For sale at forty thousand drug stores.

Dr. Shoop's Restorative

THE IDEAL SIGHT RESTORER

WE RESTORE SIGHT!

GLASSES RENDER DEFECTIVE VISION CHRONIC.

Write for our ILLUSTRATED TREATISE, Mailed Free.

THE IDEAL COMPANY, 239 BROADWAY, NEW YORK.

STYLISH SUITS

MADE TO ORDER $10

Do you want an up-to-date **All-Wool Suit or Overcoat,** made to **your measure** that will fit you perfectly, from the newest most fashionable fabrics?

Do you want to be **absolutely satisfied** with style, fit, quality and value we give before you pay for them? We will give you a pair of **All-Wool Tailor-Made**

$5 Trousers Free

with your first suit order providing you will hand our Samples, Style Book and Offer to 10 of your friends whom you believe will buy clothing this season.

We know we can **fit** you and **save you money.** In order to prove it to you, we will make you a **suit or overcoat to your order,** from your choice of any of our $10, $12.50, $15 or $18 samples, and send it to you together with the **$5 free Trousers,** and give you 5 days to decide whether you wish to keep the garments. **Isn't that a fair offer?**

Write to-day for our full line of Suit Samples in Clay Worsteds, Thibets, Serges, Tweeds and Cassimeres, in all colors, including the **new brown;** also Overcoat Samples in Irish Frieze and Kersey, and our New Style Book, showing life-like half tones of the latest style **Suits, Overcoats and Trousers. ALL SENT FREE,** together with order blank, instructions for taking measurements, etc. We will also send you a list of the persons in **your own town** for whom we have made suits. **Write today** for samples and our **Free Trousers Offer.**

OWENT. MOSES & CO., 212 MOSES BLDG, CHICAGO

References: Any one of our 900,000 Customers or The Milwaukee Avenue State Bank, Chicago. Capital Stock, $250,000.00.

IT HELPS BUSINESS

To Have Your Office Furnished With

ANDREWS' High Grade Office Fittings
ANDREWS' Typewriter Desks
ANDREWS' Typewriter Metal Chairs
ANDREWS' Office Desk, medium to best
ANDREWS' Bookkeepers' Desks & Chairs

Our designs are the Latest and Most Artistic. SEND FOR CATALOGUE.

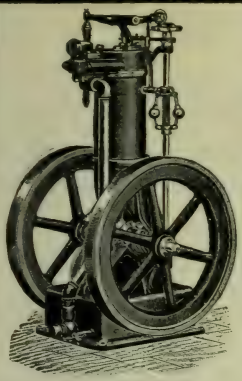
The A. H. Andrews Co.

174 Wabash Ave., - - Chicago

HISTORY OF THE POM-POM—MADE PUBLIC FOR THE FIRST TIME.

By Its Inventor.

In the course of a recent discussion on machine guns at the Royal United Service Institution, Sir Hiram S. Maxim remarked that the history of the pom-pom had never been told. He proceeded to tell it as follows: "When I went into the machine-gun business, I was simply an engineer and electrician; but I had learned my trade fairly well. I made a gun and took it down to Hythe to fire in the presence of Lord Wolseley. The authorities there had never seen such a gun before. Usually guns used to jamb; they could not fire them at all. I remember twenty years ago that there was a lecture about machine guns, and so much said about their jambing and getting out of action that the general opinion seemed to be that they were useless. When Lord Wolseley saw this gun fired at a target 600 yards away, which was made of cast iron and when we ceased firing we heard forty shots strike the target after we stopped, it was very impressive. There were a lot of bullets in the air, and a lot of waves of sound coming back, and we heard those after the gun stopped firing. I had the honor of a seat at the right hand of his lordship, and we discussed machine guns. Some of the other officers joined us while they were smoking, and they asked me if I could make a machine gun which would have a range a great deal longer than the present one, that would penetrate a torpedo boat, that the ammunition should not be too dear, and which would be quite as effective as a small gun for meeting a crowd of savages as swords. After studying the subject a long time I began. We had a large powder chamber, ¾-inch bore, a projectile the shape of those used in military rifles, but the bullet had a steel core in it, and the bullet was made in segments, and the sectors of this were made by the envelope of lead and tin. It was strong enough to hold the bullet together in flight; but if you wanted it to scatter you could move a little lever, which brought three or four points of steel in front of the middle and scratched the envelope and gave a scattering result, like grape and canister at short range. That seemed to meet every requirement. The question came as to whether it would not be considered an explosive bullet, because it all went to pieces. So I changed it so that the projectile weighed over one pound, and that was the pom-pom; and that is how the pom-pom happened to be made. That particular form of gun was very much enlarged. The first one used ammunition the same as the Hotchkiss, and afterwards they were made considerably longer for the U. S. government, and still longer for the English. So the pom-pom at the present moment is rather a powerful arm, considerably heavier than at first. It at first fired 400 rounds a minute, but I have reduced the speed down to 300."



THE BEST ENGINE BUILT for

FARM, SHOP OR FACTORY USE

Our Gasoline Engine is one of the kind that you do not have to watch continually. No sparks, smoke or danger from fire. A child can run it with safety. Sell your windmill and let Cavanaugh & Darley's Engine do your pumping. It will do almost everything on the farm—saw wood, churn, pump or shell corn, and do it quicker and more economically than by using any other power.

In machine shops and factories Gasoline Engines are acknowledged to be the best and cheapest power, and our name on an engine means perfection in Gasoline Engine Construction.

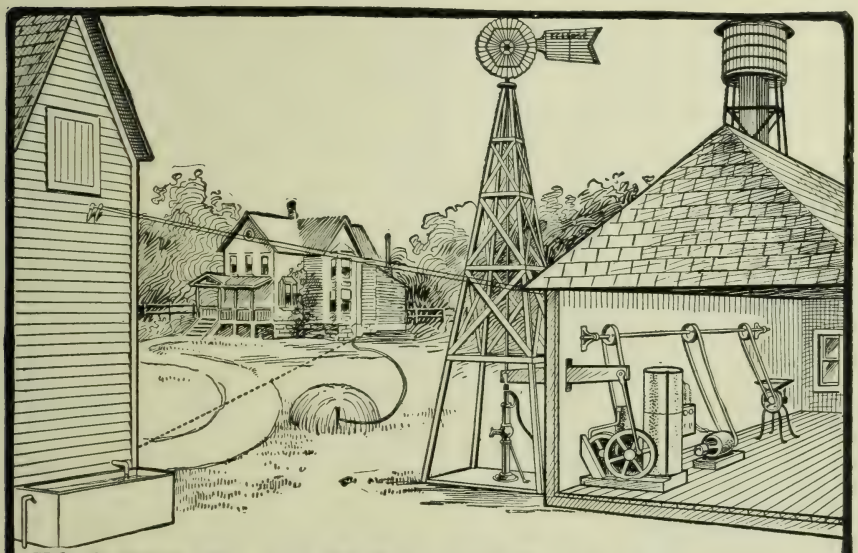
1 to 60 h. p. Also Marine and Automobile Engines.

Send for our New Illustrated Catalog

CAVANAUGH & DARLEY, 25 Randolph St., Chicago

CRANE FITTINGS

ESTABLISHED 1855



FAIRBANKS-MORSE GASOLINE ENGINES

Water Light and Power

For the Farm, Hotel or Country Home

DEPT. 449

Fairbanks Morse & Co.

Monroe St. Chicago

CUT HERE

GENTLEMEN:—Please send me illustrated catalog and prices on the Outfits I have marked by an X—

——Domestic Water and Light Plant

——Gasoline Engine for Pumping

——Gasoline Engine for Sawing Wood

——Gasoline Engine for Spraying Trees

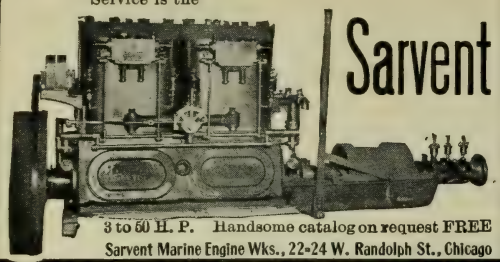
——Irrigating Outfit——Windmill——Tank——Tower

Please fill out coupon and send to us.

NAME_____

ADDRESS_____

A Good Powerful Engine for Marine Service is the



Sarvent

3 to 60 H. P. Handsome catalog on request FREE

Sarvent Marine Engine Wks., 22-24 W. Randolph St., Chicago

KEROSENE OIL ENGINE

Stationary, Marine, Portable. Send for catalog

Int'l Power Vehicle Co., 381 Dearborn St., Chicago

NOTHING BUT THE BEST

EVER GETS INTO OUR

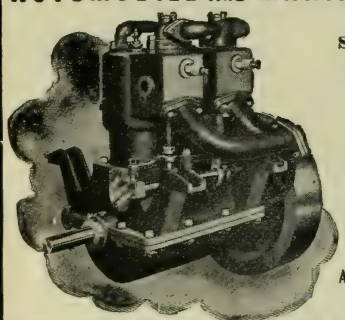
GASOLINE ENGINES

All small wearing parts are of hardened tool steel. On every piece the work is better than seems necessary, but it pays, and we are sure that our customers will appreciate it in years to come.
Catalogue of our 2¾ H. P. dust proof type for the asking.

McNAUGHTON - BASSETT CO.

CHARLOTTE, MICH.

AUTOMOBILE AND MARINE MOTORS



SIMPLE, COMPACT and POWERFUL

Best material.
Perfect workmanship.
Send for Catalog.

ALEXANDER & CROUCH,
71 W. Monroe St.,
Chicago

1, 2 & 4 Cylinder 4, 8 & 16 H. P.

ASK FOR CATALOG F.

THE "GUS" GAS AND GASOLINE ENGINES

NONE BETTER MADE

CATALOG UPON REQUEST

THE CARL ANDERSON CO.

23-27 N. CLINTON ST. CHICAGO

COOK BROS.

Marine Motors

"The Best"

PEKIN, ILL. U. S. A.

RADIANT, A NEW FUEL.

A new fuel called Radiant, to be used in connection with gas and other fires, has been invented, says the Daily Mail of London, by two young engineers of Southend, England, and if it be proved that it can do all that is claimed for it, it will cause a great revolution in the present system of gas heating as did the introduction of the Welsbach mantle in gas lighting. The inventors claim for Radiant—1. That it gives treble the heat with the same gas consumption as an ordinary gas fire. 2. That it takes up the carbonic oxide from the air and purifies the atmosphere. 3. That it does away with the unpleasant smell given off by gas fires. 4. That it burns brightly like a coal fire. 5. That it is as cheap as fire clay and is inexhaustible.

The two young inventors are connected with one of the largest firms of gas engineers in the country, and have been experimenting for years with a view to producing a fuel such as Radiant. Radiant will take the place of the asbestos or fire clay balls, and will, it is said, give out an intense heat. It is made from materials that are now waste products of chemical works. The new fuel captures the blue flame, which at present is lost, and converts it into intense heat. Radiant is also said to possess the power of retaining heat to a very great extent.

AUTOMOBILE TORPEDOES FOR HARBOR DEFENSE.

"In many harbors, owing to a great depth of water, rapid current and kindred causes, it is almost impossible to establish a reliable system of mines, and in this field the automobile torpedo is almost without a rival," declares Lieut. Lloyd H. Chandler, U. S. N. Its great advantage is in the ease with which it can be fired. The recoil of firing is not great and the regular firing tube can be set up anywhere in a short space of time. No launching apparatus is necessary; an old barrel with the heads knocked out will serve as an apparatus for pointing the torpedo, and while two men stand in the water and point it, another pulls the starting lever, and good firing results.

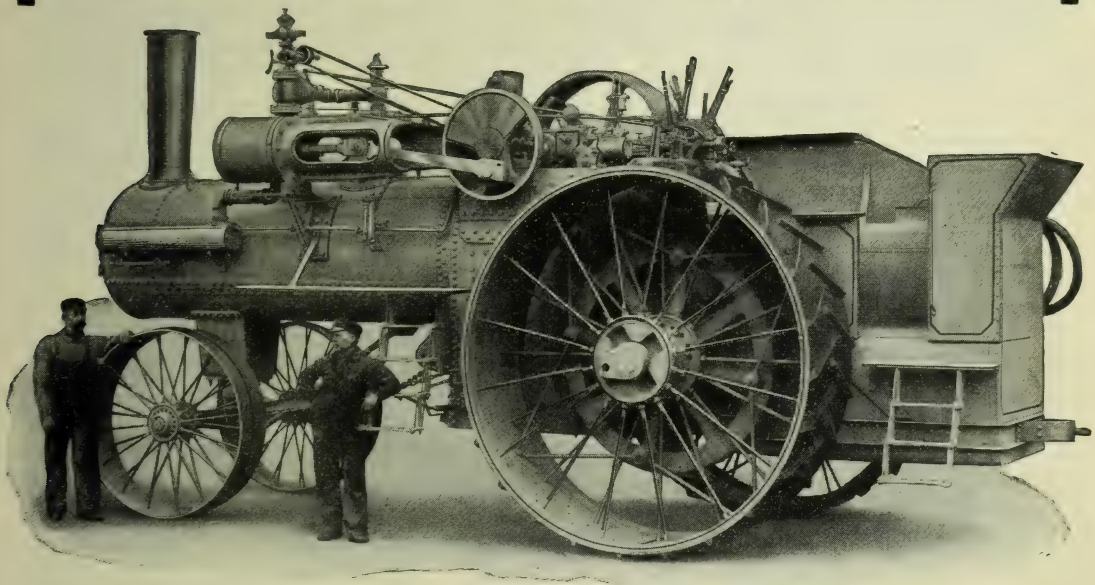
For submerged firing from a stationary battery on shore a coffer-dam can be extemporized from any available material by an average carpenter's gang, and an above-water tube from which the spoon has been removed, secured in a hole in the coffer-dam by a form of sluice valve. This style of harbor defense, says Lieut. Chandler, offers powerful advantages.

From permanent shore batteries, by using a torpedo double the size of those used aboard ship, a range of 5,000 yards at 30 knots could be attained by a torpedo carrying 200 pounds of explosive, and for the first 1,000 yards the speed would be over 40 knots. Range and the position of the enemy can be readily determined from a shore battery so that such a weapon would be absolutely accurate.

Mr. Chandler believes that the use of the automobile is an absolute necessity in many harbors and would render forcing a harbor or maintaining a successful blockade impossible except at a cost too great for any nation to contemplate.

BUY A ROAD LOCOMOTIVE

It will not only save you money, but will earn a profitable income



The picture on the front cover as well as the descriptive article on page 1210 refers to the Monster Road Locomotive manufactured by the

J. I. CASE THRESHING MACHINE COMPANY

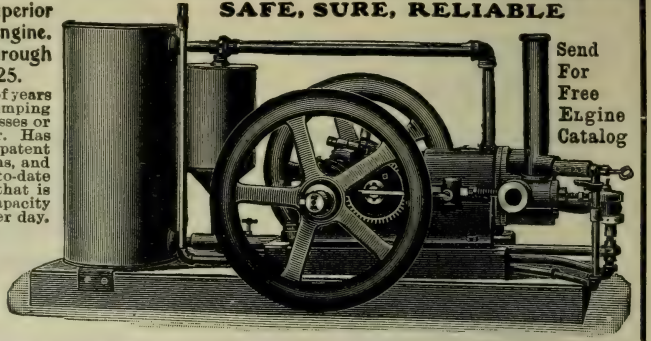
Racine - - - Wisconsin

Write for Catalogue No. 16. This catalogue contains a vast amount of valuable information to anyone interested in an economical, portable power machine

69.50 "Little Giant" One-Horse Gasoline Engine

Equal or superior to any other 1-Horse Engine. Similar Engines sell through agents for $100 to $125.

SAFE, SURE, RELIABLE



Send For Free Engine Catalog

This engine has been on the market for a number of years with good success. It is especially desirable for pumping water, for operating cream separator, printing presses or other machinery requiring not over one horse-power. Has two fly wheels, 15 in. in diameter, that weigh 80 lb., patent catch governor, permitting no useless compressions, and all necessary accessories, of the most modern, up-to-date patterns, ready for immediate operation. All that is necessary is to fill tank and start. Its pumping capacity has been known to be several thousand gallons per day. It is constructed of first-class material and is carefully tested before being sent out. Can be operated at an expense of about one cent per hour. Weight about 225 lb. Floor space necessary is 3 ft. 10 in. x 22 in. **Send for Free Engine Catalog**. We have other engines that will interest you.

MONTGOMERY WARD & CO., . Chicago

Hydrozone

Cures

Sore Throat

A Harmless Antiseptic.

Endorsed by the medical profession. Send ten cents to pay postage on **free trial bottle.** Sold by Leading Druggists. Not genuine unless label bears my signature:

Prof. Charles Marchand

L-63 **Prince St., N. Y.**

Write for free booklet on Rational Treatment of Disease.

HOLD-UP INSURANCE

The Pencil Pistol is the smallest 32 caliber pistol made. Convenient and safe. Can be concealed in the hand. Carry it always and it will protect you against holdups. Price, postpaid **$1.50**

Agents Wanted. Sells on sight. **G. S. Webber, 21 Stone St.,** Chicago

Clark's Cruise of the "ARABIC"

15,801 tons, one of the finest, largest and steadiest steamers in the world

TO THE ORIENT

FEBRUARY 2 TO APRIL 13, 1905,

Seventy days, costing only $400 and up,

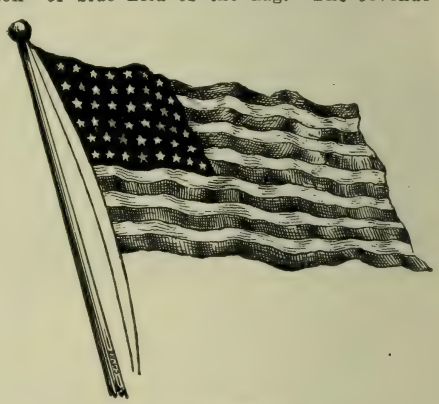
INCLUDING SHORE EXCURSIONS.

SPECIAL FEATURES: Madeira, Cadiz, Seville, Algiers, Malta, 19 days in Egypt and the Holy Land, Constantinople, Athens, Rome, the Rivieras, etc. Tickets good to stop over in Europe. ALSO TOURS TO EUROPE.

FRANK C CLARK 113 Broadway, New York

THE NATIONAL FLAG.

The official flag of the United States bears forty-five stars in a blue field, arranged in six rows—the first, third and fifth rows having eight stars each, and the others having seven stars each. The garrison of the army is made of bunting, thirty-six feet fly and twenty feet hoist; thirteen stripes, and in the upper quarter, next the staff, is the field or "union" of stars, equal to the number of states, on blue field, over one-third length of the flag, extending to the lower edge of the fourth red stripe from the top. The storm flag is twenty feet by ten feet and the recruiting flag is nine feet nine inches by four feet four inches. The "American Jack" is the "union" or blue field of the flag. The revenue ma-



THE NATIONAL FLAG.

rine service flag, authorized by act of Congress, March 2, 1799, was originally prescribed to "consist of sixteen perpendicular stripes, alternate red and white, the union of the ensign bearing the arms of the United States in dark blue on a white field." The sixteen stripes represented the number of states which had been admitted to the union at that time, and no change has been made since. Prior to 1871 it bore an eagle in the union of the pennant, which was then substituted by thirteen blue stars in a white field, but the eagle and stars are still retained in the flag. June 14, the anniversary of the adoption of the national flag, is celebrated as flag day in the public schools, and by the display of the emblem on public buildings and private houses in a large part of the union.

Our readers can help Popular Mechanics very greatly if they will kindly call the attention of some friend to the magazine. If you like it, there are others who would, if only they knew about it. Please tell some one friend about "Pop."

WE MANUFACTURE

STAPLE GOODS AND SPECIALTIES

IN CAST BRASS AND SHEET METAL

Estimates Furnished from Models or Blue Prints — Correspondence Solicited

FROST MANUFACTURING COMPANY

37-53 SOUTH PLEASANT ST. : : : : : KENOSHA, WIS.

BRAZE CAST IRON

With our new compound. BRAZIRON, used with ordinary spelter and borax makes the brazed joint stronger than the solid cast iron. Work can be done in any forge or brazier. A good specialty for bicycle and blacksmith shops.

Every machine shop needs it. Send 60 cents for one box Braziron by mail postpaid. One box contains enough for twenty to fifty or more jobs. Send $1.00 and get our HANDY BRAZING OUTFIT, containing one box Braziron, one box flux and one coil wire spelter, by mail postpaid. Agents wanted to introduce Braziron in shops and factories.

WRITE AT ONCE FOR FULL PARTICULARS

THE A. & J. MANUFACTURING CO., 17 So. Canal St., Chicago. Ill.

Patents, Metal Specialties, Novelties, Tin and Aluminum Boxes

We make them all and anything in the metal line---Punches and Dies---Special Tools and Machinery---Boxes of special design and patterns; also experimental work at reasonable rates. All work guaranteed.

GREENLEAF & BACON, : : 42 and 44 Michigan Street : : Chicago, Ill.

MAGIC BILL BOOK

FUN

The slickest thing out—Get one and you will have them all guessing. Bills placed in the Magic Bill Book change from one side to the other in a mysterious way. No one can explain it. Substantially made and will last a lifetime. Prices, 10 cents, postpaid, 3 for 25 cents.

W. H. Miller Supply Co.,
727 East 4th St., - - St. Paul, Minn.

"WE ANALYSE EVERYTHING"
AT REASONABLE RATES
Should you want to know what is contained in any preparation or product, address
THE ELLSWORTH LABORATORIES
MAX D. SLIMMER, Ph. D.
357 DEARBORN STREET, - - CHICAGO

WHEN you want the address of any manufacturer, machine or device and don't know where to get it--just ask Popular Mechanics.

"HASTINGS" Compound for Dynamos and Motors

POCKET SIZE, 60 CENTS

Money refunded if it don't do the work. This is the only compound sold with a guarantee.

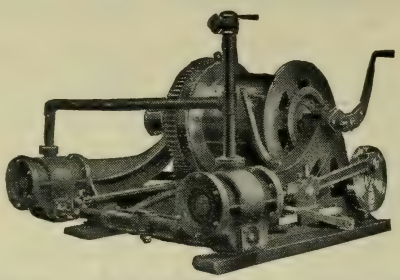
JAS. L. NEEFUS, Sole Agent, - - 45 Dey St., New York City

MANUFACTURERS

Burlington Route

Why not locate where intelligent labor, raw material and demand for your product obtains. All these and more found on the BURLINGTON ROUTE. For information write to

W. H. MANSS, Industrial Commissioner
209 Adams Street - - - - - - - - Chicago



THE QUINCY HOIST

8 x 10	Cylinders, Drum 14 x 20,	$496
8 x 10	Cylinders, Drum 24 x 24,	$505
8 x 10	Cylinders, Drum 30 x 30,	$525

YOUR CHOICE; FRICTION OR REVERSIBLE

Delivery f. o. b. Quincy, Ill., or Chicago

No discount from above prices.
Will ship subject to inspection and approval.
Modern, Quick, Strong, Efficient. Just the thing for pulling up cars or for small mines. Got 'em in stock. Order one.

WILLIS SHAW, - - Chicago
SOLE DISTRIBUTOR

NEW AND SECOND-HAND ELECTRICAL **MACHINERY**

COMPLETE PLANTS INSTALLED.

Expert Electrical Repairers of Armatures, Fields and Commutators.

ILLINOIS ELECTRICAL MFG. CO.
1222 S. Adams St. : : : Peoria, Illinois

WANTED 10 men in each state to travel, tack signs and distribute samples and circulars of our goods. Salary $75.00 per month, $3.00 per day for expenses.

KUHLMAN CO., Dept. D, Atlas Block, CHICAGO

LOW PLUMBING BILLS
Get them by paying right prices for supplies. We sell

SUPPLIES AT WHOLESALE
You save 20% to 40% on every article. Highest grade goods and line complete. Free illustrated catalog gives all particulars. Write for it.

B. P. KAROL,
229 W. Harrison St., Chicago.

Are You a Lover of
Good Tea and Coffee

We are making a Special Proposition to those who enjoy a beverage that is not only delicious, but more appetizing and nutritious than any other tea and coffee on the market.

THE GREAT AMERICAN TEA COMPANY

Write for **Special Christmas Proposition** to persons getting up clubs or sending orders of $5.00 and upwards.

It is worth your while, as we intend to use unheard-of efforts to increase the number of customers during the next two months.
This offer applies only to readers of Popular Mechanics

Write us at once—to-day—to
MR. CARL,
Great American Tea Co.,
31 & 33 Vesey St., P. O. Box 289, New York

SELF-PROPELLING FIRE ENGINES PRAISED BY A BOSTON FIRE CHIEF.

At the convention of the International Association of Fire Engineers held at Chattanooga, Tenn., in September, Chief W. T. Cheswell, of Boston, Mass., read a paper on self-propelling engines in which he stated that two of these engines were installed in the very heart of the hazardous fire section, with a fairly busy running card and that from the date of going into service they had averaged 50 runs a year.

"These engines," Chief Cheswell adds, "are what is termed a double extra first size engine, both of like construction and dimensions, weighing 17,000 pounds. Diameter of cylinder, 9½-inch; diameter of pump, 5¾-inch; length of stroke, 8-inch; capacity, 1,200 to 1,300 gallons a minute. When at their stations there is 90 pounds of steam pressure registered on the gauge at all times, this steam being supplied from a heater in the basement of the station, and connected by steam pipe to engine. This heater will consume about three tons of coal a month.

Upon receipt of an alarm to which the engine responds it is immediately started, the fire under the boiler not being lighted until crossing the threshold, the boiler gradually gaining steam until, on arrival at the fire after the shortest run, the gauge will register 125 pounds.

"After the engine is placed in the position required a key that connects driving gear to main shaft is removed, and we then have the ordinary steam fire engine ready for work.

"These engines are equipped with a fresh water tank holding 100 gallons that in case of necessity can be refilled from any hydrant, a short piece of 2½-inch hose being carried for this purpose; but as they run three miles without refilling the tank, in my recollection it has never been necessary to stop for water.

"Our self-propelling engines have given excellent service, and not one instance is recorded where they failed to report at the scene of the fire in good season; and there is an instance in my recollection in responding to an alarm during a heavy snowstorm, an engine drawn by five horses was stalled, and one of these propellers cut through the same snow drift without much ado. In ordinary going they can be driven as fast as required.

"They can climb quite a grade; in fact one of them is on the running card to a box at the top of a long hill in preference to an engine drawn by horses located at the same station. They can be housed after returning from response to an alarm very quickly and without much work. Their repairs have not been noticeably in excess of our horse engines.

"The spur tires are renewed but once a year on the forward wheels and three times on the rear wheels."

The chief expressed the opinion, however, that no matter how good this apparatus, even with its great water capacity, results will not be satisfactory unless it is intelligently operated, and that the success depends entirely on the rank and file of the department, who must drill constantly.

TALC PRODUCTION OF 1903.

The talc or soapstone production of the United States during 1903 was 86,901 short tons, a decrease of 11,053 tons as compared with 1902. The value of the 1903 output is placed at $840,060. The production is classified as rough, sawed into slabs, manufactured articles, and ground talc. Fibrous talc is in great demand among paper manufacturers as a filler for paper and from the fact that its fibrous character gives additional strength to the paper.

Novelties Made to Order

we'll show you how to place your invention on the market and make money.

CHICAGO RIFLE MANUFACTURING CO., 11-21 SO. JEFFERSON ST., CHICAGO

Metal Stamping
We make Dies and Tools that will turn work out cheaply. Write us—

CRANE VALVES
ESTABLISHED 1855

WE CAN MANUFACTURE ANYTHING IN

Brass, Aluminum, Phosphor-Bronze or Gun Metal

We also manufacture Refrigerators, Beer Pumps, Faucets and Supplies.

Our Prices are reasonable. Write us.

U. S. SPECIALTY MFG. CO., - 33 Washington St., Chicago

A Roth Motor will Drive Any Kind of a Machine Tool

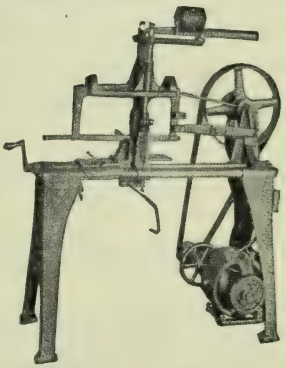
No shafting, pulleys or belting to maintain. The motor running any machine not in use can be shut off.

Considering Economy, Efficiency and Design, the ROTH MOTOR is beyond reach of competitors.

Self-oiling, noiseless in operation, free from sparking and automatic in its speed regulation at variable loads.

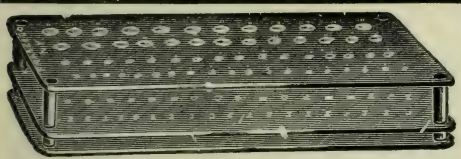
Write us of your motor wants and we will send illustrated catalogue free.

ROTH BROS. & CO., Manufacturers,
27-31 So. Clinton Street, CHICAGO



A Roth Motor Drives this Hacksaw.

Frasse Combined Drill Gauge and Block



This Gauge gives all sizes of Drills, Nos. 1 to 60. The holes are numbered showing just the drill looked for. The two lower plates serve as a support to keep the drills uniform. Everyone should have one of these. This will be mailed for 75c., postage 8c.

FRASSE ROLLER BOILER TUBE EXPANDER

This Expander suits any automobile boiler tube measuring 1-2 in. inside. Made of Stubs' steel, carefully ground to exact size. The rollers cannot drop out.

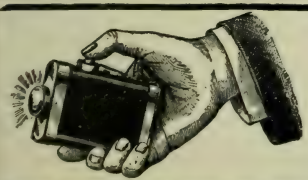
Mailed for $2.00, postage 8c. Bargains in Machinists Tools at less than wholesale rates. Catalogue 1845 mailed for 25c and refunded with order for $3. H. F. FRASSE COMPANY, 38 Cortland Street, New York.

If you want anything and don't know where to get it write us.

If you have a new idea or invention ask our Patent Bureau what you want to know and they will answer promptly and fully without charge.

We want a mechanic in every shop to act as our agent. Write for particulars.

POPULAR MECHANICS CO.



THE RELIABLE

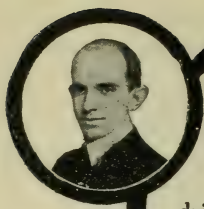
ELECTRIC VEST POCKET LIGHT

IF you wish to find a house number at night; if you wish to find an article you have dropped; if you wish to avoid dangerous places in dark streets, just "press the button" and you have an instant, brilliant light. Will give eight thousand flashes, or burn three months with right usage. Inexpensive to buy and to operate! Invaluable to physicians, or miners and gasfitters who go in dark places where any other form of light is dangerous. Batteries and bulbs easily detached and renewed when required.

$1.00—Complete—$1.00 Postage prepaid. Extra batteries 30c. Extra bulbs 35c

Write for prices in quantities and complete catalog. Agents wanted. HOWARD ELECTRICAL NOVELTY CO., 183 Lake St., Chicago.

Please mention Popular Mechanics when writing advertisers.



If you wish to buy or lease on royalty, patents on hardware or mail-order specialties, machinery, in fact anything, write to me.

INVENTORS

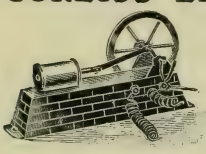
desirous of selling their patents quickly and to the best advantage should register with me. I can save you time and money.

I SELL PATENTS

CHARLES A. SCOTT,
796 Mutual Life Building,
Buffalo, N. Y.

CORLISS ELECTRIC ENGINE

ONLY 75 CENTS



A complete Miniature Corliss Engine, with stop, start and reversing throttle lever, fitted with grooved power pulley. Runs at a high speed consuming 1-2 ampere of current when connected to almost any kind of battery. Nickle plated parts and red foundation to represent brick. PRICE, 75 cents. Postage and packing, 15 cents. AGENTS WANTED. Outfit complete with two batteries, wire and instructions, $1.00; postage and packing, 35 cents.

SEND STAMP FOR ELECTRICAL CATALOG

Ithaca Electric Nov. Co., Box 64, Ithaca, N.Y.

IDEAS PATENTED May Bring a Fortune.

Fee refunded if unsuccessful. Write for free Booklet on Inventions. Send rough sketch for free report as to patentability. Patents obtained by me advertised free in Chicago papers.

JOHN L. KINDT
Patent Attorney, 31 Randolph Street, CHICAGO

NAME PLATES, TRADE MARKS

THE MEYERCORD CO.
DECALCOMANIA TRANSFERS
NAME PLATES, TRADE MARKS AND ORNAMENTS
OPALESCENT TRANSFER WINDOW SIGNS
CHAMBER OF COMMERCE BLDG. CHICAGO

TRANSFER WINDOW SIGNS

MODELS AND SUPPLIES

Send for Illustrated Catalog of Appliance for Models

J. WEINERT & CO., 134 Pierce Avenue, Chicago

HARDWARE AND METAL SPECIALTIES

Manufactured on Contract

PUNCHES AND DIES
SPECIAL TOOLS
GEAR CUTTING

CRAIG MANUFACTURING CO.
39-43 West Washington St., Chicago, Ill.

SPECIAL MANUFACTURING

Dies and Stamping

--TO ORDER--

SPECIAL MACHINERY, MODELS EXPERIMENTAL WORK

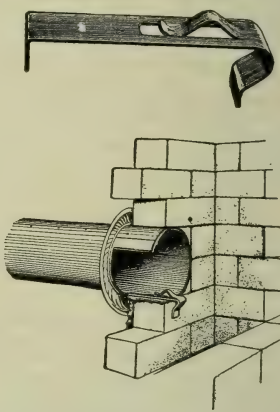
DROP FORGING DIES AND DROP FORGINGS

Hardware Specialties, etc., Manf'd to Order. Send Samples or Drawings for Estimates. Write for Our Booklet.

THE GLOBE MACHINE & STAMPING CO.
973 Hamilton St., - Cleveland, Ohio

STOVE PIPE HOLDER.

An ingenious device has recently been patented which prevents the stove pipe from either pulling out of a chimney or getting too far in. The device is shown in the first cut and the second illustration shows it in place in a chimney. It consists of a flat band of spring steel bent to a right angle at the room end and to an incomplete S shape at the



chimney end, as shown in Fig. 1, the shape of the inner end providing some compensation for varying thicknesses of room plaster. Before the pipe is inserted in the hole, as shown in Fig. 2, this holder is sprung into place at the bottom of the opening, and the pipe is pushed into the tongue at its inner end. No tools are needed in attaching it to the pipe.

The owner of an English automobile says it travels so fast that on leaving home the other day he stooped over to say a last word to his wife, when his car suddenly started and he kissed another man's sister five miles away.

"Reader."—The process of making filter tubes is secret and is carefully guarded by manufacturers.

PATENTS Valuable and Salable Patents Secured. Advice as to Patentability and Commercial Value Free

SHEPHERD & PARKER, PATENT LAWYERS

"During the past 10 years Mr. Shepherd, of Shepherd & Parker, has obtained for us a great many important patents. We have no hesitation in heartily recommending him to anyone having need of the services of a patent attorney.

HALLWOOD CASH REGISTER CO.

Mr. Parker on Nov. 1, 1903, resigned his position as an examiner in the U. S. Patent Office to enter this firm.

Address
210 Revenue Building . . WASHINGTON, D. C.

PATENTS

Valuable Book on Patents FREE. Tells how to secure them at low cost. How to sell a Patent and What to Invent for Profit. Gives Mechanical Movements invaluable to Inventors. Full of Money-Making Patent Information. NEW BOOK FREE to all who write.

O'MEARA & BROCK, Patent Attys., 918 F. Street, Washington, D. C.

NEW YORK OFFICE, 288 Broadway, New York City

CATALOGUE FREE TO ANY ADDRESS

PARTS OF

MODELS AND GEARS

UNION MODEL WORKS, 191 S. Clark Street, CHICAGO

GEAR CUTTING — EXPERIMENTAL WORK

YOUNG ENGINEER'S GUIDE. By J. V. Rohan, Racine, Wis. Pocket size; 254 pages; illustrated. Price, leather, $1.25; cloth, $1.00.

In its thirty-second edition, revised and enlarged, this practical guide is still popular among young men who are striving to attain perfection in this line. The author and publisher of the book was an employee of the J. I. Case Threshing Machine Co. for seventeen years and writes from the practical standpoint of a man who has carried the responsibility of the matters of which he writes. The little volume contains a large amount of concise information, further strengthened by exhaustive questions and answers and helpful tables.

MODELS CHICAGO MODEL WORKS
175-181 E. MADISON ST., CHICAGO, ILL.
WRITE FOR CATALOGUE OF MODEL SUPPLIES
ESTABLISHED 1867

RHEUMATISM

Cured Through the Feet

THOUSANDS ARE BEING CURED AT HOME EVERY MONTH BY THIS NEW DISCOVERY, WHICH IS SENT TO EVERYBODY TO

TRY FREE—PAY WHEN SATISFIED.

The son of S. J. Pearce, health officer of New Westminster, B. C., had rheumatism so badly that he couldn't walk alone. Magic Foot Drafts cured him in a week.

Mrs. Mary Patrick, Watertown, N. Y., for more than a year couldn't get up from her chair. Magic Foot Drafts cured her.

The Drafts cured Z. H. Palmer of Pittsburg, Pa., who had suffered twenty-eight years.

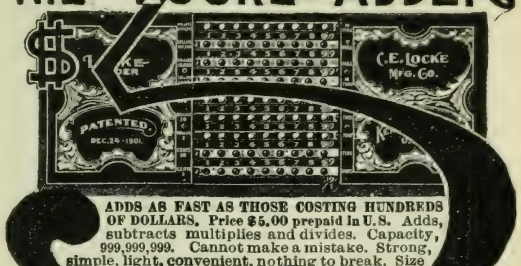
H. C. Van Valkenburg, Providence, R. I., writes: "I don't believe any person ever had muscular rheumatism as bad as I have had it and recovered so quickly, for which I thank your Magic Foot Drafts."

Letters from the above and many thousands of other cured patients are on file in our offices, where anyone can see them.

We want the name and address of every sufferer from rheumatism. Write us today. Return mail will bring you—free to try—a pair of the famous Magic Foot Drafts, the great Michigan discovery which is curing all kinds of rheumatism, chronic or acute. If you are satisfied with the benefit received from the Drafts, send us one dollar. If not, keep your money. **YOU DECIDE.**

The Drafts are worn on the feet because the largest pores are there; but they cure rheumatism in every part of the body—to stay cured—because they absorb the acid impurities from the blood through these pores, and reach the entire nervous system through the extremely sensitive nerve centers of the feet. Don't suffer needlessly, but send your name today to the Magic Foot Draft Co., 1251 Majestic Bldg., Jackson, Mich. The Drafts, together with our splendid new free book on rheumatism, will come by return mail. Send no money—only your name. Write today.

THE LOCKE ADDER

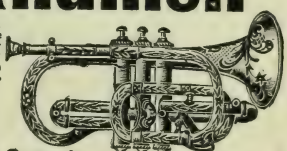


ADDS AS FAST AS THOSE COSTING HUNDREDS OF DOLLARS. Price $5.00 prepaid in U.S. Adds, subtracts multiplies and divides. Capacity, 999,999,999. Cannot make a mistake. Strong, simple, light, convenient, nothing to break. Size 4x10¾ ins. Write for Free booklet. Agents wanted. C. E. LOCKE MFG. CO., 98 Walnut Street, Kensett, Iowa.

Buy a Locke Adder and Save your Brain

Bandmen

Don't buy instruments of any kind until you have seen our prices.



$8.95 E♭ Cornet

excellent Windsor model. B♭ Windsor $9.50. Professional Solo Le Bevre Cornets, twelve models, genuine Courtois instruments. Our illustrated Musical Instrument Catalogue contains everything known in music. Everything from grand pianos to violin strings. Write at once for catalogue and study our wholesale prices. Bandmen particularly should have our catalogue. A postal will bring it.

Montgomery Ward & Co.

Michigan Ave., Madison and Washington Sts., Chicago

9

"IF SLEEPING, WAKE,

If feasting, RISE before I turn away." It is the hour of FATE 'Tis

OPPORTUNITY

the ruler of human destinies, that speaks Of many books there's ONE YOU NEED 'Tis unpretentious, and its name?

"A Guide to Full Pockets"

That's what most mortals need and if thy needs are common with the rest, here is the mystic key to fortune, fame and joy.

'Tis FREE, for fortune's smiles can ne'er be bought. Thousands have read and quickly grasped the offered boon. 'Tis now thy turn—this call the last to you. If heeded not you'll seek in vain for that which will return no more. Send thou a postal card and we will tell thee all.

THE NUTRIOLA CO., 142 W. Madison St., Chicago, Ill.

LEARN BOOKKEEPING FREE

Would you like to succeed in business, to obtain a good paying position, to secure an increase in salary? Would you possess the capacity that directs and controls large business enterprises? If so, you should follow the example of Mr. Edw. Chapman, of No. 606 So. 5th St., Goshen, Ind., who largely increased his salary after taking our course. A knowledge of accounts increases your opportunities a hundred fold. Our method excels all others. You can learn quickly at home, without loss of time or money. We guarantee it.

A GREAT BOOK FREE

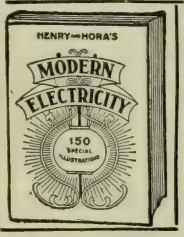
"How to Become an Expert Bookkeeper" is the title of an extensive treatise on Bookkeeping and Business. It tells of the best system of accounts ever devised, and explains how you can make more money and better your position in life. It is just the book for beginners and experts alike. To advertise our system we will give away 5,000 copies absolutely free, without any condition whatever. Simply send your name and address and receive the book without cost. Address

Commercial Correspondence Schools,
147 P Commercial Bldg., Rochester, N.Y.

We Teach You FREE: We Secure A Position For You.

Greatest Electrical Book

Modern Electricity
By HENRY & HORA



Is full of information invaluable to you if you are interested even remotely in this great science. It is a new and most complete encyclopedia containing full descriptions of electrical devices and machinery, systems of transmission and distribution—treating most minutely every important branch, including X-Rays, wireless telegraphy, radium, power stations, wiring, etc. In compiling this book the authors have studiously avoided theories and technical phrases which discourage the efforts of the average reader. Modern Electricity is written in that plain good English so desirable to everyone and appreciated as well by experts. 355 pages, Cross index.

THE PROBLEMS OF ELECTRICITY SOLVED

A boon companion for the electrical engineer, workman, apprentice or student.

PRACTICAL : ACCURATE : SCIENTIFIC

But above all simple
Absolutely original matter prepared by expert electrical engineers, never published before.

150 ILLUSTRATIONS
drawn especially for this work.

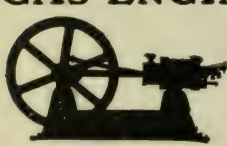
Silk Cloth Decorative Cover, Silver Stamping, : : : $1.00
Seal Leather, Marbled Edges, Gold Stamping, : : : : 1.50

Laird & Lee's Imprint on Scientific and Mechanical Books Guarantees Reliability.

AT YOUR DEALER'S OR
SENT POSTPAID ON RECEIPT OF PRICE.

LAIRD & LEE, PUBLISHERS, 263-5 Wabash Av. **CHICAGO**

GAS ENGINE CASTINGS



for the Franklin One-Half Horse Power Gas Engine. Castings, Materials, Drawings, etc., for amateurs. An ideal motor for practical use. Not a toy. Complete set of castings, etc., for either horizontal or vertical type, **$16.50.**

Send for illustrated booklet 8.

PARSELL & WEED, 129-131 West 31st St., New York City

A BAD SCRAPE and a smooth easy shave are such different propositions that it should interest you Mr. Home Shaver to know that our high grade Diamond Edge XX Strop sharpens the dullest razor quicker and better than ordinary strops. Save everything, —— face, razor, time, temper and money by using a Diamond Edge. By mail, $1.00. Money back if you say so.

LOW MANUFACTURING COMPANY, DEPT. K,
67 Dennis Street, Roxbury, Mass.

BOOK REVIEWS.

PAGE'S WEEKLY, LONDON; that always interesting and highly attractive monthly magazine. Page's Monthly is now issued as a weekly and, if possible, is better than ever. Price 6d. per copy.

AUTOMATIC SURVEYING INSTRUMENTS and Their Practical Uses on Land and Water. By Thos. Ferguson. Illustrated; 87 pages, cloth. John Bale, Sons & Danielsson, Ltd., Oxford House, London. Price $1.00.

This book adds a new chapter to all that has been published on surveying instruments and puts on record some modern advances in this field. It gives full information concerning the pedograph, an automatic route-tracer for pedestrians; the cyclograph, an automatic route-tracer for vehicles, and the hodograph, self-registering of courses and distances on water.

PIPE FITTINGS AND VALVES. By W. D. Browning. 82 pages; numerous illustrations; 50 tables of dimensions. The Draftsman, Cleveland, O. Price, leatherette, 75 cents; flexible cloth, 50 cents, postpaid.

This little book contains all the information required on pipe fittings and valves, including many useful diagrams, tables and descriptions of styles. It is especially designed for the use of designers, architects, draftsmen and engineers in drawing out pipe work. Lays flat when open.

HODGSON'S NEW HARDWOOD FINISHING, including Wood Manipulation, Staining and Polishing. By Fred T. Hodgson. In two parts; illustrated; 203 pages. Price $1.00. Frederick J. Drake & Co., Chicago.

The first part of this book gives many rules and methods of working hardwoods with descriptions of the tools required and methods of using them, also instructions for caring for these various tools. The second part treats of filling, staining, varnishing, polishing and finishing all kinds of wood work. It gives many practical methods of renovating old work and contains a valuable chapter on dyeing woods in various colors for inlaying and marquetry work. The book includes so much of practical value, giving all explanations and demonstrations in such a clear, understandable manner, that it is hard to do it justice in a brief paragraph.

DOWN TO THE SEA IN SHIPS.

Statisticians find that something like 2,000 vessels of all sorts disappear in the sea every year, never to be heard from again, taking with them 12,000 human beings, and involving a money loss of $100,000,000. Still we like to think the world advances steadily toward the millennium.—Boston Transcript.

PEANUTS and POP CORN

A BUSINESS THAT PAYS

Machines are earning from $35 to $60 per week. Catalog Free.

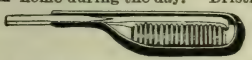
S. DUNBAR & CO.
18 & 20 No. Desplaines St.
CHICAGO

THREE TIMES A DAY

is none too often to brush the teeth, if you would preserve them and keep mouth and gums healthy and sweet. This

Folding Tooth Brush

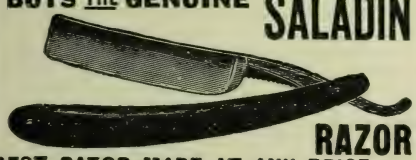
makes frequent brushing possible. Can be carried in pocket, hand bag or satchel. Wonderful comfort and convenience to business men and women, travelers and others who are away from home during the day. Bristles are protected and dry out readily. Black enamel steel handle, price, postpaid, only 25c. The **"ELITE" BRUSH** just a little nicer, with highly nickel finished handle, postpaid, 50 cents.



These goods are money makers for agents, men or women. Write for terms. Cash or money order must accompany order.

ADDRESS
CHICAGO COMMERCIAL AND SPECIALTY CO.
530 W. 63d Street, Chicago

$1 BUYS THE GENUINE SALADIN RAZOR



THE BEST RAZOR MADE AT ANY PRICE.

Hand forged from the finest razor steel in the world. Made and tempered by experts, ground by hand, ⅝ inch blade with double shoulder, set ready for use. Fully warranted. We guarantee satisfaction. If the razor we send you is not right **EVERY WAY**, we replace it until you are completely satisfied. A trial will convince you. Don't pay $3 to $5 for a razor no better or not as good.

Postpaid on receipt of $1.00. Address
HOME MERCANTILE CO., Dept. 24, Crossdale, Ill.

CO-OPERATION

is the mystic key to fortune, fame and happiness. We hold the **key**, but cannot turn it alone. We will share with **you** in the greatest **money-making** co-operative business on earth. We are **giving away 250,000 shares** of Treasury stock. Par value $1.00 per share. Not a share can be bought for cash.

There's 20 Shares for You

No more for anyone. **We don't want your money**, don't send us a cent, just a postal card. Our plan is **unlike** that of the trusts who give millions of shares to drones, called "promoters." We are giving ours to **partners**—energetic men and women. This stock will pay large dividends and costs you—just a **little** effort—**that is all**—fortune's knock is at your door, believe it or not, as you please.

THE PEOPLE'S COMPANY
144 West Madison Street, Chicago

Half a Man Half a Salary

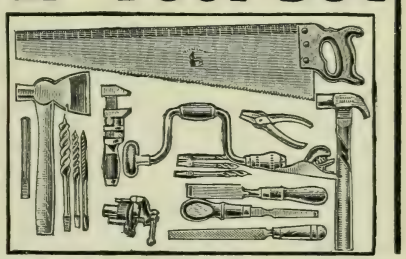
The half-sized salary goes to the man who has but half developed his abilities. If you are earning but half what you need, we can qualify you for promotion in your present work or prepare you for a more congenial position and better salary. We are doing it right in your own district every day for others, to whom we can refer you. The accounts of the rise of some of our students read like romance. Many have risen from the lowest to the highest positions in their calling.

We teach Engineering in all its branches; Architecture; Mechanical Drafting; Ad Writing; Show-Card Writing; Window Dressing; Illustrating; Ornamental Designing; Bookkeeping; Stenography; Etc.

Write today, stating which Course interests you.

International Correspondence Schools
Box 872, Scranton, Pa.

$2.70 Tool Set



18 warranted tools of best quality—just the set to keep around the farm or house. The above cut shows our 18-piece Star set at $2.70,-complete; 28-piece set, $7.30; 36-piece set, $9.70; 41-piece set, $10.70; 50-piece set, $16.75, and up to our Carpenters' 95-piece set at $39.25. If you want Tools of any kind write us for our wholesale price list. We have the largest stock of hardware in the world for sale direct to the user. Tools for every trade, engineers' supplies, building material and building hardware. Write at once for our 634-page Mechanics' Catalogue—a book quoting lowest wholesale prices on standard, guaranteed goods. Catalogue free to any address.

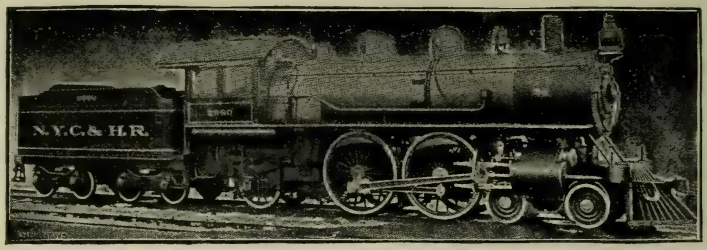
Montgomery Ward & Co. 15
Michigan Ave., Madison and Washington Sts., Chicago.

POPULAR MECHANICS
Can give you the address of the maker of any
MACHINE OR TOOL

TYPEWRITERS ALL MAKES
All the Standard Machines Sold or Rented Anywhere at Half Manufacturers Prices. Shipped with privilege of examination. Send for cata'g
Typewriter Emporium, 196 La Salle St., Chicago

ELECTRIC RAILWAYS

Perfect Working Models of Locomotives, Trolley Cars, Interurban Railways, Dynamos, Motors, Gas Engines, Castings, etc.



We carry the most complete line of Electrical Novelties and Experimental Apparatus. Everything for the Amateur Electrician.

Write for our New Catalogue "B No. 9."

THE CARLISLE & FINCH CO., 262 East Clifton Avenue, CINCINNATI, OHIO

BOYS, WRITE TO US

and let us show you how easy it is to become an electrician. Our catalog for boys shows everything in motors, dynamos and electrical goods. Sent free to anyone. As a special inducement we send this motor for $1.50 with directions for operating. Send 15c in stamps to pay mailing charges. **Julius Andrae & Sons Co.**, 483 West Water St., Milwaukee, Wis.

$1.50

ELECTRIC MOTOR 75c.

Runs with a wet or dry battery, ask any electrical dealer or look through any electrical catalogue and see if you can buy an electric motor with 2-inch armature, wrought iron field magnet, pulley, etc., for 75 cents, packing and postage, 15 cents.

CATALOG FREE

Dry batteries for operating motors, induction coils, small electric lights, and experimenting, 25 cents each, postage and packing, 10 cents. Send 10 cents for 10 feet of magnet wire for experimenting and making small magnets.

Artesian Electric Co., 744 Artesian Ave., Chicago

$3.60 A $50 Watch for $3.60

Chain and Charm FREE.

GUARANTEED FOR 30 YEARS

This is a Genuine Gold-Filled Engraved Watch in appearance, double hunting-case, stem-wind & stem-set, and fitted with a high-grade ruby jeweled movement. Send us this ad. and we will send the WATCH, WATCH CHAIN AND CHARM C.O.D. $3.60 and express charges. Make careful examination then pay express agt. $3.60 and express charges and it's yours. Write if you desire Ladies' or Gents' size.

GUARANTEE WATCH CO., Dept. 216, Chicago.

Mysterious CHANGING CARDS

With these cards you can do the most wonderful tricks. You can make trays fade into blank cards, blanks into aces and aces into deuces, etc, No practice necessary. Send for a pack and be a real wizard. PRICE ONLY 10c., POSTPAID, with full secret direct'ns. Address WESTERN SPECIALTY CO., 532 E. Minnehaha St. St. Paul, Minn.

SPECIAL DOLLAR ELECTRIC BARGAINS

Electric Pocket Light . . . .
" Scarf Pin . . . . .
" Motor . . . . . .
" Bell Outfit . . . . .
" Top. . . . . .
" Shocker . . . . .
" Induction Coil. . . .

$1

We keep all Electric Novelties. Send for catalogue.

Electric Novelty Co.
16 E. Market St.
INDIANAPOLIS IND.

CONSCIENTIOUS WORK IN SECURING PATENTS.

Popular Mechanics Patent Bureau is organized to conduct a legitimate patent business in the interests of inventors. We realize that the success of our clients with their inventions means the upbuilding of our business, so we do everything in our power to insure such success. Our ambition is to obtain the largest number of strong patents on sensible inventions—hence we do not encourage taking out patents on inventions that have no prospect of commercial success. As between the man who has produced an invention and the manufacturer who is trying to steal it, we stand by the inventor every time, and we don't claim any credit for doing it. Popular Mechanics is for the man with brains, and our Patent Bureau is run in his interest. If an invention is brought to us to patent and with the aid of our mechanical experts we can see a way to improve it, we give the inventor the benefit of such improvements without extra expense—it pays in the long run and we expect to have a long run in the business.

SELF-DUMPING FRUIT PAIL.

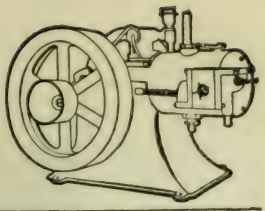
The cut easily explains itself: The pail is for the use of fruit pickers who want to empty their pail on the ground without coming down, or bruising the fruit. The Ohio Farmer says: A is hooked over limb while picking. To lower, A and B are hooked together and on reaching ground B instantly unhooks when a simple pull on rope dumps pail and returns same to picker. An old ear is riveted at C, into which rope is fastened. All that is required are a pail, rope and some stiff wire. This saves getting down out of the tree for every pailful and is even better than two ropes, which are always twisting up and causing trouble.

MAGIC

I will teach you one new coin trick and one new card trick for 20 cts. or either for 10 cts. I will send *"Book of Card or Coin Tricks,"* 180 p., 25c. each, and include illus. catalog of 240 tricks free with order. Learn at home, amaze your friends, mystify, startle and entertain. ROBERT WASSMANN, Instructor in Magic, 227-z Webster Ave., CHICAGO, ILLINOIS.

Please mention Popular Mechanics when writing advertisers.

High Grade Gas and Gasoline Motors



Special types (castings or finished motors) for Bicycles, Automobiles, Launches and Stationary use, either air or water cooled. All except the stationary are of the latest French design, powerful, light and far ahead of any American built motor. Motors are easily built from our castings. Sizes 1-4 to 6 H. P. Prices right.

Circulars 2c. Handsome new catalogue 4c. Write now—don't delay.

We also make mechanical drawings and models. We develop inventor's ideas.

C. S. PIPER & CO., 4352 Cottage Grove Ave., **Chicago, Ill.**

Magic Trick Cards.

With these cards you can perform some of the most wonderful illusions. You can change eights to duces, blacks to reds, etc., The transformations are truly wonderful. **Price, 10 cents** with instructions, and our Big Bargain Catalogue.

Address

Western Specialty Co., 532 E. Minnehaha St., St. Paul, Minn.

WONDERFUL STOVE — BIG MONEY MAKER!

BURNS 90% AIR—ONLY 10% OIL-GAS.

7200 sold one month. Customers delighted with **Harrison Valveless Oil-gas Stove. Splendid for cooking; also heating** rooms, stores, offices, etc., with Radiator Attch. No wick, dirt, or ashes—no coal bills or drudgery—cheap, safe fuel, 15c to 30c a week should furnish fuel-gas for cooking for small family. Easily operated—absolutely safe—all sizes, $3 and up. **Write—Catalog FREE and Special Prices. AGENTS WANTED—$40 Weekly.** Call in or address

WORLD MFG. CO., 5790 World B'ld'g, Cincinnati, O.

MEN EVERYWHERE

To learn how to make new and resilver old mirrors. Immense profits in the work and we guarantee you success. We tell free of charge how to emboss, etch, foil, gold leaf, gild, frost and chip glass. Send for particulars and start at once.

G. L. Patterson & Co., Chicago, Ill.

ELECTRIC MOTOR

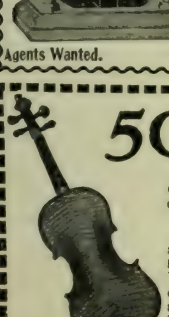
The Rienco Motor runs at high speed when connected to one cell of almost any kind of battery. It rotates in either direction and is reversed without changing connections. It is fitted with grooved pulley. Price, 50 cts. Postage and packing, 15 cents.

Motor Outfit No. 8

consists of 1 Rienco Motor; 1 Rhe stat, or speed regulator; 2 Small Dry Batteries and 10 feet of wire. Price, $1.00. Postage and packing, 30 cents. **Send stamp for catalog.**

Medical Coil and Shocker, postpaid, . . . $ .60
Electric Door Bell Outfit, complete, ...75
Electric Light Outfit, complete, postpaid, . . 1.05
Electric Automobile, complete with rubber tires 3.50
Electric Top, postpaid, ...95

Agents Wanted. Ithaca Electric Nov. Co., Inc. Box 64 Ithaca, N. Y.



50 Per Cent Off

Our Catalogue Prices

Hereafter we will give to the public direct in full all teacher's and dealer's discounts on

Violins, Guitars, Mandolins

and other stringed instruments. Our **standard Lewis Orchestra, No. 1, Violin** (worth easily $25 to $30 among dealers; listed in our catalogue for years at $21; now **$10.50 net** direct to you). The famous Lewis Durer $65 violins for $32.50. Other values from $3.50 to $125.00 and upward. We are the largest and oldest exclusive stringed instrument house in the U. S. and import direct from **our own** workshop in Eisleben, Germany and Paduah, Italy.

Ten Days Free Trial of any instrument. Write for Catalog.

WM. LEWIS & SON, 211 B Wabash Avenue, CHICAGO

☞Specialty in strings for professional trade.

FOR CHRISTMAS

Our novelties are not toys—but are useful, practical and durable. Appropriate and pleasing for Christmas gifts for men, women and children—hundreds of delightful Christmas suggestions in our handsome catalog—write for it to-day.

THE "MAGIC" POCKET SEARCHLIGHT, shown in illustration above, is very useful for clergymen, farmers, plumbers, miners, railroad men, bankers, hunters, travelers—in the home—in fact, everywhere a bright, safe light is wanted. No heat, matches, chemicals. Operated by dry batteries. Does not break—lasts for years. Only **$1.00** complete. Many other styles and prices.

ELECTRIC CLOCKS—good time-keepers, handsome, ornamental, all styles and prices from **$3.75** up.

MOTORS in every style, size and price from **75c.** up.

ELECTRIC LOCOMOTIVES, trains and trolleys, with tracks, switches, bridges, etc. No better plaything can be found for your child. From **$5.00** up.

ELECTRIC WALKING CANE.—An unusually attractive novelty. Is a handsome cane and in addition has a bright searchlight. From **$2.25** up.

ELECTRIC CANDLES—in hundreds of styles. Very attractive for parlor, library, dining room, dressing room, etc. From **$3.50** up.

LEARN TELEGRAPHY—complete outfit, high-grade telegraph key, sounder, battery, wire and complete instructions for learning. Only **$2.25.**

A PRIVATE TELEPHONE, guaranteed to ring and talk a distance of 1,000 feet, including wires, screws, staples, two complete instruments and instructions for installing, only **$1.00.**

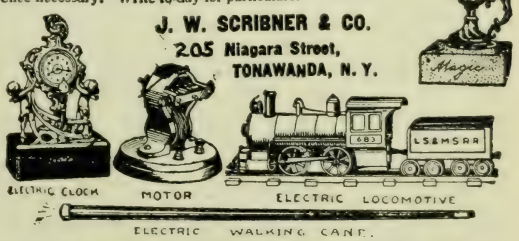
OUR NEW CATALOG, illustrates and describes over 100 other novel and useful electrical novelties ranging in price from **75c.** to **$30.00.** We want you to see it. Sent free on request. Write to-day.

AGENTS make big money quickly selling our goods. No experience necessary. Write to-day for particulars.

J. W. SCRIBNER & CO.

205 Niagara Street,

TONAWANDA, N. Y.



This ELEGANT Watch $3.75

Before you buy a watch cut this out and send to us with your name and address, and we will send you by express for examination a handsome **WATCH AND CHAIN C. O. D. $3.75.** Double hunting case beautifully engraved, stem wind and stem set, fitted with richly jeweled movement and guaranteed a correct timekeeper; with long Gold plated chain for Ladies or vest chain for Gents. If you consider it equal to any **$35.00 GOLD FILLED WATCH Warranted 20 YEARS** pay the express agent $3.75 and it is yours. Our 20 year guarantee sent with each watch. Mention if you want Gents' or Ladies' size. Address

H. FARBER & CO., C31, 28 Quincy St., CHICAGO.

The World's Headquarters for

ELECTRIC NOVELTIES and SUPPLIES

If It's Electric We Have It.—We Undersell All

Xmas Tree Lamps & Battery	$3.00
Fan Motors, $2.00 to	$15.00
Battery Table Lamp	3.10
Battery Hanging Lamp	10.00
Telephone, complete, $2.50 to	5.95
Electric Door Bells,	1.00
Electric Carriage Lamps,	5.00
$8.00 Medical Batteries,	3.95
$12 Belt, with Suspensary,	2.50
Telegraph Outfits,	2.00
Battery Motors, $1.00 to	12.00
Bicycle Electric Lights,	3.50
Electric Railway,	3.25
Pocket Flash Lights,	1.25
Necktie Lights,	1.00

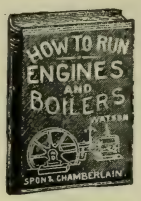
SEND FOR NEW CAT., JUST OUT

$3 Electric Hand Lantern. Agents Wanted.

OHIO ELECTRIC WORKS, ∴ Cleveland, Ohio

25c. BOOKS

on Electricity, Mechanics and other subjects. Send for price list **FREE**



HOW TO RUN ENGINES AND BOILERS

by E. P. Watson. Written in plain language and fully illustrated.

7,000 COPIES SOLD

SAMPLE COPY OF THE "MODEL ENGINEER" SENT FOR 8 CENTS

SCHNEIDER.—Care and Handling of Electric Plants. - - ***$1.00***
The most successful book.

DAHLSTROM.—Fireman's Guide to the Care of Boilers. - - ***.50***

NORRIE.—Induction Coils and Coil Making for All Purposes. ***$1.00***
Fully illustrated

CROMWELL.—Easy Lettering for Draftsmen. - - - - - ***.50***

JUST OUT

Paint and Color Mixing. The most practical book on this subject, 171 samples of colors $2.50

SPON & CHAMBERLAIN, Publishers of Technical Book Dept. PM, Liberty Bldg., New York

BUBIER'S
POPULAR ELECTRICIAN

3 mos. 10 cts.

THE ONLY AMATEUR ELECTRICAL PAPER IN U. S. SCIENTIFIC BUT NOT TECHNICAL.
EDITED BY EXPERT ELECTRICIANS.
DEPT. 3 LYNN, MASS. 3 YEARS, $1

HOW TOGO'S NERVES WERE STEADIED.

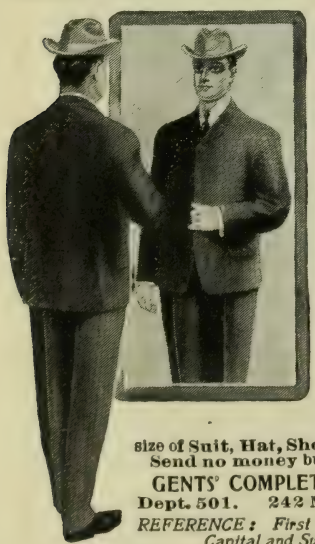
Admiral Toga, commander-in-chief of the Japanese navy, whose prowess as a fighting man has won world-wide praise of late, comes from an old school of Nippon warriors. His naval education is of the best, and he has been trained in every way to be a fearless, calm, and tireless fighter.

In his youth, he and his fellow students at the Japanese naval academy were accustomed to attend an annual banquet. They sat at a circular table around a slowly revolving cannon loaded with a ball and trained to the level of their heads. The trigger was so arranged that it could be touched from a hidden source outside of the banquet hall. That at some time during the banquet the cannon would be fired every one at the table knew; but just when, or in what direction it would be pointing was a mystery. Of course, there was a possibility that the ball might crash harmlessly between the heads of two banqueters, but it was equally probable that it might carry off the head of some student. Yet no one flinched. The chances were equal to all.

The picturesque object of destruction revolving during the jovial hours of the banquet, pointing from student to student, and ready at a given moment to blow any one of them to pieces, was considered in Japan admirable training.

$8.00 Outfit Free

A Dunlap block, Derby or Fedora Hat.....$2.50
A pair of stylish Lace Shoes, the new queen last **2.50**
A Percale Shirt, detachable Collar and Cuffs.... 1.25
A Neat Silk Four-in-hand Necktie or Bow..... .50
A pair of fancy Web Elastic Suspenders..... ..... .50
A Japanese Silk Handkerchief..... .50
A pair of fancy Lisle Thread Socks..... .25
Thousands of American citizens pay cash for this.....**$8.00**



To introduce our famous made to measure custom tailoring we make this unequaled offer of a **GENUINE CHEVIOT Suit made to your measure** in the latest English Sack Style, well made and durably trimmed, for only $10. *Equal to your local tailor's $20 suit* and give you all the above complete outfit **FREE.** Send us your name and address and we will send you

Free Samples

of cloth, measurement blank and tapeline for size of **Suit, Hat, Shoes and Shirt.**
Send no money but write to-day to

GENTS' COMPLETE OUTFITTING CO.
Dept. 501. 242 Market St., CHICAGO

REFERENCE: First National Bank, Chicago; Capital and Surplus, $12,000,000.

WONDERFUL TREES OF OTHER CLIMES.

The wonders of botany are apparently inexhaustible. One of the most remarkable specimens is the Mexican maguey tree, which furnishes a needle and thread all ready for use.

At the tip of each dark green leaf is a slender thorn needle that must be carefully drawn from its sheath; at the same time it slowly unwinds the thread, a strong smooth fiber attached to the needle and capable of being drawn out to a great length.

Five years ago the attention of American importers was called to the value as an astringent and drier in varnish, for the finer kinds of furniture, of the product of the Chinese wood oil tree.

Since then two American firms have established branches at Hankow, China, for the exportation of the oil, and one of them has shipped nearly 200,000 gallons since last fall. Because of the fact that no barrels are manufactured in the provinces where the oil tree grows, a Hankow firm has imported from New York shooks for 5,000 barrels and machinery for setting them up

Real Estate Mortgages at 6%

SAVINGS DEPOSITS AT 3%

GOVERNMENT BONDS AT 2%

ARE SAFE, BUT YOUR INCOME FROM THEM WILL NOT ADD MATERIALLY TO YOUR WEALTH

Your Investment

SHOULD BE PROFITABLE

A Mining Investment, if a successful one, yields larger Profits on the money invested than any other

THE Stock of **THE NORTH AMERICAN EXPLOITATION COMPANY** offers the opportunity for large profits that you are seeking. This Company's holdings are large and valuable. Its seven properties are developed and producing mines. Five are equipped with mills and reduction plants. Over $1,250,000 was originally paid for the properties and over $700,000 has been expended in their development and equipment. There are over 75,000 tons of ore now in sight worth over $1,500,000. Its combined earning capacity permits of large and continuous dividends. Its "Eggs are not in a single basket." It is not a question of "Will it pay?" but, "How much?"

IT SHOULD ALSO BE SAFE

Every purchaser of the Treasury Stock of the Company, receives, to the extent of his investment, a **FIRST LIEN GOLD BOND**, bearing 6 per cent guaranteed interest, payable on or before 5 years, secured by the entire assets of the Company—this makes your investment safe, besides effecting the return of your money within a brief period, and leaving the stock you hold, as a bonus.

The first allotment of Treasury Stock is now offered for subscription at a special "organization" price. For Prospectus, Copy of Bond and full particulars, address,

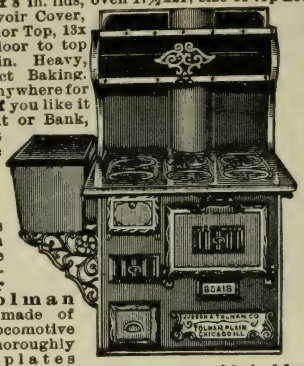
THE WESTERN TRUST & GUARANTEE CO.

FISCAL AGENTS

New York Life Bldg. **CHICAGO, ILL.**

$45.00 TOLMAN Steel Range 23.75

Exactly as shown with **15 Gal. Reservoir and Hi Closet.** Six 8 in. lids, oven 17½x21, size of top not including Reservoir Cover, 28x36 in. Reservior Top, 13x24 in., height, floor to top High Closet 55 in. Heavy, Durable, Perfect Baking. We ship range anywhere for examination. If you like it pay R. R. agent or Bank, $23.75 and freight and take range home for



30 Days Free Trial

If not exactly as represented in every way, we **cheerfully return your money. Tolman Ranges** are made of best Wrought Locomotive Steel Plate. Thoroughly rivited. Oven plates braced. Flues lined with Asbestos. Burn any kind of fuel

Guaranteed Five Years Will save their cost in one year. We deliver exactly what we advertise. Send order, or send for our Catalogue E today,

JUDSON A. TOLMAN COMPANY
Dept. W-70. 66 Lake Street, Chicago

A GOOD Drawing Table

CASH WITH ORDER. PRICE, $5.00

Adjustable to height and angle. Top of hard or soft wood 20 x 28 inches. Shipped in the knock-down by freight. Weight 50 lbs. Circulars free of full line of Tables.

The Hetterschied Mfg. Wks.
317 S. Division St.
GRAND RAPIDS, MICH.

Columbia No. 1

Lowest Prices

for musical goods of the right quality. We sell only the very best grades, the only kind you can afford to buy if you expect satisfactory results.

$1.95 up to $50.00 is our range of prices on violins, 27 different styles to select from. Each instrument absolutely dependable, and offered to you at our wonderfully low wholesale prices.

$2.50 buys the genuine Rockwell guitar. 12 other makes at prices lower than can be found anywhere else for instruments of the same quality.

$2.95 is our wholesale price to you for a genuine Glenwood mandolin, an instrument that sells for $4.00 to $6.00 elsewhere.

We handle everything in musical goods and will gladly send our interesting catalogue to any person who can possibly use a musical instrument of any kind. Ask for Musical Instrument Catalogue.

Montgomery Ward & Co.,
Michigan Ave., Madison and Washington Sts., Chicago.

GLYCERIN GLUED SHUT HEAVY VAULT DOORS.

Twelve days were spent by experts lately in trying to open the steel door of a vault of a Dayton, Ohio, trust company. The door was at last opened with a crowbar. A small steel hook slipped in through one of the holes bored in the steel, had hauled back the lock frame unknown to the expert who was at work. The crowbar was tried as a last resort before burning the door to pieces by elec tricity.

Inside it was found that a thin stream of glycerin had leaked from the glycerin cup, trickled down the lock frame and hardened, practically glueing the door shut by not permitting the frame to slide back far enough to release the bolts. The glycerin is in a cup at the center of the door. In this cup works a piston which breaks the jar of the springs when they are released by the time lock and unlock the door. The glycerin, the expert thinks, had probably been leaking drop by drop for many weeks.

The job of opening the door was the biggest that experts had found in years and many of them said it broke all records. Skilled men appeared from all over the country to proffer advice during the twelve days of hard work. One day a man came in and quietly announced that he could get into the safe in a short time, that, in fact, he made his living by getting into safes. The "expert's" picture was thought to be in the rogues' gallery at the central police station, so his services were not accepted.

It took four days of constant drilling to put the first hole through the door of the safe. Then, after knocking away all lose mechanism inside, a second one was drilled through by electricity in eighteen hours. Through this the time lock was knocked down and many other things put out of business. But still the door held. Then the bank officials suggested drilling through three feet of the side wall, which is made of concrete and crisscrossed bars of steel. The expert objected. Then they suggested his going through the five-foot wall in the rear and again he objected.

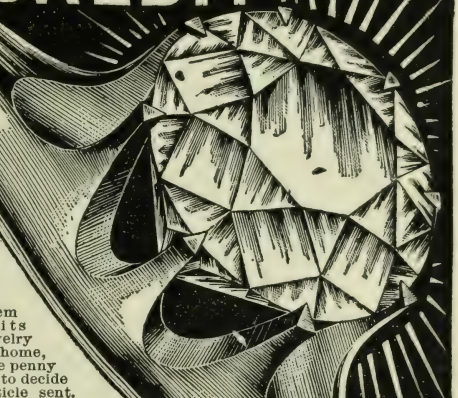
Finally all hope of opening the door without ruining it or the entire vault was given up and expert electricians were summoned to attack it. But one expert didn't like to give up and kept on tinkering at it. With a long steel hook he reached inside the door through the last hole bored and caught hold of the glycerin box and pulled. Nothing seemed to move and the hook was thrown on the floor in disgust.

Just to prove to himself that the door would not open, he had the safe company's expert pry on the hinges with a crowbar. Without the least bit of trouble the door slowly swung out. Five minutes later the electricians walked in with supplies of carbon, coils and tools, but they were sent home. They had predicted that they could open the door in four hours by burning a hole in it large enough for a man to insert his hand and manipulate the locks. But the hole would have spoiled the door. As it was, the two small holes, about an inch in diameter, could be plugged up and the broken mechanism repaired, making the door stronger than ever.

Immediately after opening the main door bookkeepers were called in and set to work fixing up the books for the twelve days they have reposed quietly in the safe. The watchman was also given an extra word of caution. But to the layman the safe still seemed absolutely impregnable, for, after getting through a second door almost as large as the first and a steel gate, you are only in the vestibule of the vault. To reach the inner precincts another steel gate has to be opened to get to a last safe, which also has two doors.

Trying to select Christmas gifts? Send for Popular Mechanics Premium List.

CHRISTMAS DIAMONDS ON CREDIT



The

Gold Medal

has been awarded to the

LOFTIS SYSTEM

by the Judges at the Saint Louis Exposition. This is the highest endorsement possible, and puts the official stamp of the greatest exposition ever held upon our goods, prices, terms and methods, against all competition, foreign and domestic.

What is the Loftis System? It is the system which permits the far-away buyers to select the finest Diamonds, Watches and Jewelry from our beautifully illustrated catalogue and have them sent to their home, place of business or express office on approval. You need not pay one penny for express charges or otherwise—we pay everything—leaving you free to decide whether to buy or not after the fullest examination of the article sent.

Credit Terms. If what we send meets with your entire approval, you pay one-fifth on delivery and keep the article, sending the balance to us direct, in eight equal monthly payments. These terms make anyone's credit good, and permit us to open **confidential charge accounts** with all classes and conditions of people. The ten-dollar a week employe is just as welcome as a customer on our books as is his wealthy employer.

Cash Terms. We also have a cash plan, and it is just as far beyond competition as our easy payment terms. Read this: Select any Diamond and pay cash for it, and we will give you a written agreement that you may return the Diamond anytime within one year, and get all you paid for it—less ten per cent. You might, for instance, wear a fifty dollar Diamond ring or stud for a year, then bring or send it back to us and get forty-five dollars, making the cost of wearing the Diamond for a whole year, less than ten cents per week.

Guarantee and Exchange. With every Diamond we give a written guarantee of quality and value signed by a member of the firm. We also accept any Diamond ever sold by us as so much money in exchange for a larger Diamond or other goods. Every transaction with our house will be satisfactory—our record is a guarantee of that. In 1858 a very small jewelers shop—today the largest house in the business, and winner of the World's Exposition Gold Medal.

Christmas Selections. Don't wait to make Christmas selections for you can save time, money and worry by doing it now. We have Christmas gifts suitable for friends, relatives and loved ones, all at low prices and on terms to suit any purse. Don't make the mistake of buying something cheap or trashy—the same money would make the first payment on a beautiful Diamond ring, stud, brooch, locket, a pair of cuff buttons or earrings, or a fine watch. A Diamond is the ideal gift for a loved one—it lasts forever, and every day reminds the wearer of your regard and good judgment.

Christmas Catalogue. Our handsomely illustrated **Christmas Catalogue** is ready and will be sent postpaid on request. Write for it today, and do not make a single selection until you have received it. It will save money for you, and is the best possible guide you can have to reliable goods, satisfactory dealings and convenient terms of payment. Notwithstanding the fact that we have the greatest capacity and best facilities in the world for handling business expeditiously and satisfactorily, we strongly urge upon you the advisability of ordering your selection early. Our Christmas business is something enormous; mistakes are vexatious; delays are dangerous. **Write today.**

Souvenir. You will receive in addition to our Christmas Catalogue a copy of our beautiful Souvenir History of Diamonds, more than a million copies of which have been distributed at our Diamond Cutting Exhibit in the Varied Industries Building at the Universal Exposition, St. Louis. Write at once to insure receiving a copy.

LOFTIS BROS. & CO.

Diamond Cutters and Manufacturing Jewelers

Dept. P. 173, 92 to 98 State St., Chicago, Ill.

SAVE A DIAMOND

DIAMONDS WIN HEARTS

Copyright, 1904, Franklin Advertising Agency, Chicago.

TELEGRAPHY

Telegraphers' Penmanship and Typewriting

COMBINED IN ONE TUITION

We are unable to meet the demands of the railroads for our graduates. Positions guaranteed to all our students. Send for catalog.

The Chicago Railway & Commercial Institute

97 Washington St., Chicago, Ill.

Air Brush for Art Work

WE ARE MAKING THE STANDARD.

The best in use for applying color by a jet of air. Enables you to do better work in less time. Found in every complete studio. Circular free.

WRITE TO-DAY

Air Brush Mfg. Co.,

127 NASSAU ST. ROCKFORD, ILL., U. S. A.

DRAWING STUDENTS NEED THE DRAFTSMAN

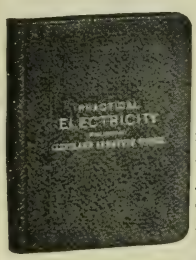
25c for 4 months—Cleveland, Ohio

Telegraphy

taught thoroughly. Institution established 1874

Endorsed by officials Railroads and W. U. Tel. Co. Positions secured. **Entire cost**, tuition (telegraphy and typewriting, board and room, **6 Mos. course, $89. Can be reduced.** Home nstruction also given. Catalogue W free.

Dodge's Institute of Telegraphy, - - Valparaiso, Ind.

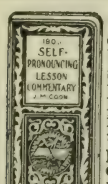


A School Within Itself

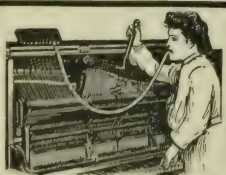
Space will not permit our telling you all about this book, but better still, we give you a chance to examine it for yourself by our offer to refund money if book is not satisfactory upon examination. Under this offer, 11,000 copies have been sold and paid for, and out of this number we have refunded for only fifteen copies. There are nineteen chapters, carrying you from the fundamental principles of electricity through the art to the finished dynamo. Contains a dictionary defining 1,500 words.

3rd Edition. Price, $2.00 delivered.

CLEVELAND ARMATURE WORKS, Cleveland, Ohio



SELF-PRONOUNCING COMMENTARY on **SUNDAY SCHOOL LESSONS for 1905,** by **REV. J. M. COON.** All the Lessons in self-pronouncing form, with right to the point HELPS. Small in size, but large in suggestion. Daily Bible Readings, Topics of Young People's Societies, also Benediction, Pledge, etc. 128 pages, **Pocket Size.** Red Cloth 25c, Morocco 35c, Interleaved for Notes 50c, prepaid. Stamps taken. **Agents Wanted.** **GEO. W. NOBLE, Lakeside Bldg, Chicago.**



GOOD PIANO TUNERS

Earn $5 to $15 Per Day

We can teach you quickly BY MAIL. The new scientific Tune-a-Phone method endorsed by highest authorities. Knowledge of music not necessary. Write for free booklet.

NILES BRYANT SCHOOL, 220 Music Hall, - - Battle Creek, Mich.

Engineering MECHANICAL, ELECTRICAL, STEAM, CIVIL.

Complete and short courses. Thoroughly equipped engineering shops. Shop work from the beginning. Short courses in Steam and Electrical Engineering. Expenses low. Accommodations the best. School all year. Students may enter any time. Correspondence steam and electrical courses. Send for catalogue. Mention course in which interested.

HIGHLAND PARK COLLEGE, Des Moines, Ia.

TELEPHONE WILL NOT SUPPLANT TELEGRAPHY IN DISPATCHING TRAINS.

The report has been widely circulated by the newspapers that the Chicago, Burlington & Quincy railroad company has decided on making a sweeping change in their system of dispatching trains and will replace the telegraph with the telephone system just as rapidly as it can be brought about. This report is entirely in error. The company has made auxiliary use of the telephone for this purpose on a few unimportant branches, just as many other big railway systems in America have done, but further than this has made no change in this direction, nor contemplates any at present.

It is, indeed, much doubted that the telephone will ever supplant the use of telegraphy and the efficient Morse code. There has been a great deal said on the matter, but the practicability of such change still rests with the future to prove.

TICKING EGGS FOR SETTING HENS.

A Minnesota man who takes great pride in a small, well-stocked poultry farm has discovered a reliable method of preventing hens from setting at any and all seasons on anything that comes handy, from eggs to door knobs. He procured a cheap watch which has a loud, clear tick and had it enclosed in a white egg-shaped case. Whenever a hen begins setting out of season the poultry man places the ticking egg beneath her. The noisy egg worries the setting hen, and she stirs it around, thinking the chicken within wants to get out. With the continued ticking her nervousness increases; she is apt to leave the nest and move frantically about, but at last realizing that all her demonstrations are of no avail she abandons the nest.

The genius who devised this neat little scheme uses six of these eggs and claims that it pays in that the hens continue laying instead of setting.

A NEW FISHWAY.

A new fishway will be finished at Oregon City, Ore., next spring to enable salmon to reach the tributaries of the Willamette, where few of them have ever been able to get.

This fishway should have been built years ago, as the people of the Willamette valley need salmon and other sea fish that thus far have been unable to climb the falls.

"HOW TO ILLUSTRATE" $1.00

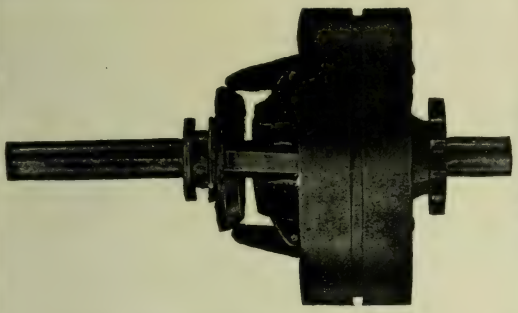
AND

"ART OF CARICATURE" $ .50

Teach thoroughly drawing and illustrating, in all its branches. Price, both books, **$1.25** postpaid. 16 pg. illus. cat'g on request.

BROWN PUBLISHING CO.,

Room 908 114 Fifth Ave., New York.



Transmissions

The "Standard" 8 and 20 H. P. MADE FOR USE. Best of WORKMANSHIP and MATERIAL. Write for our descriptive matter, and prices. Send 5c postage for 90 page catalogue of all supplies.

The Automobile Supply Co.

Successors to THE P. J. DASEY CO.

339 Michigan Blvd. Chicago, Ill., U. S. A.

RED LIGHT RENDERS VACCINATION PAINLESS.

No more lame arms from being vaccinated if the discovery of Dr. Hugo Goldmann, a Hungarian physician, comes into general use. The Journal of the American Medical Association says: He vaccinated forty children in a room like a photographer's "dark chamber," that is, lighted only by a red lantern. The arms were then dressed with red cloths applied to exclude the light. A slip of photographer's sensitized paper was placed under the dressings to serve as a test for the exclusion of the chemical rays, and also to learn whether the dressings were tampered with. In each instance the pustules, it is said, developed typically, but without the slightest inflammatory reaction. The scar was typical, although small, and there were no general symptoms of any kind. Subsequent inoculation was always negative. The other arm was vaccinated in the usual way on some of the children, with the result that it became swollen and painful, with more or less fever and general symptoms.

AN INTOLERABLE SUSPICION.

The janitor of a small school tendered his resignation to the committee, and remarked, in the course of his letter, that the suspicion upon him was unbearable.

He was called before the board for an explanation.

"Well, gents," he said, "I am honest, and I won't stand being suspected. If I find anything about the school when I am sweeping, I always return it. Every now and again the teacher, or some one that is too cowardly to face me, gives me a slur.

"Why, a little while ago I read on the blackboard: 'Find the least common multiple.' Well, I looked all over the school for that; and I shouldn't know the thing if I met it in the street.

"Last night, in big writin' on the blackboard, it said: 'Find the greatest common divisor.' 'Well,' I says to myself, 'both of them things are lost now, and I'll be accused of stealing 'em, so I'll quit!' "

ONE COPY "POP" READ BY 440 MEN.

A single copy of Popular Mechanics furnished interesting reading for 440 men each issue for several months. The copy was first read by one of our subscribers and then mailed to a young friend on board a training ship in the U. S. navy. The young man home on furlough last month said: "My Popular Mechanics went the round each month until every one of the 440 apprentices and several of the officers had read it. By the time it finished its cruise among the men it was worn out and in tatters and I don't believe its editor even would have recognized it."

THERMO-PILES

1½ Volts **1½ Amperes**

For Electrolytic Analysis, Charging Storage Batteries, Driving Small Motors, Etc. No chemicals, no smell. **$3.00 EACH.**

WALSH'S SONS & CO., 261 Washington St., Newark, N.J.

ECLIPSE POCKET AMMETER

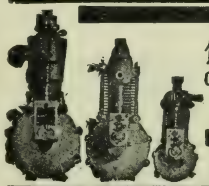
For General Battery Testing. 0 to 20 Amperes

Flexible cord attached and contact spur in case, which is DRAWN BACK INTO CASE, when carried in pocket. Size of watch and very light weight. Can be used in any position. Particularly designed for Auto use.

PRICE $5.00

ELDREDGE ELECTRIC MFG. CO.

227 Main Street, Springfield, Mass



1¾ H. P. Bike Motor, $7.50

CASTINGS WITH DRAWINGS, Latest Model

We also have them in 2 1-2 H. P.

For fuller information address

Eureka Mfg. & Supply Company,

St. Paul, Minnesota

SPROCKETS

and EQUALIZING GEARS

IN STOCK OR TO ORDER.

Standard makes of Chain on hand.

Prompt delivery.....Catalogue free.

CULLMAN WHEEL CO., 522 Larrabee St., Chicago

A MOTOR-CYCLE AT SMALL COST

By using one of our Attachable Outfits. THOROUGHLY PRACTICAL. In USE FOUR YEARS. Also a complete line of Motors, Castings and Accessories for Bicycle, Automobile Marine or Stationary.

Send stamp for Catalogue.

STEFFEY MFG. CO.

Brown and Pnenock Sts., Philadelphia, Pa.

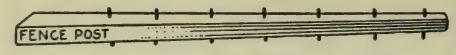
IMPORTED IMITATION

DEDION SPARK PLUGS JUST NOW - - - 40 cent each

THE MOTOR CAR SUPPLY CO.

1427 Michigan Ave., Chicago, Ill.

CEMENT FENCE POSTS



Cheap as wood, and will last forever. Made with simple and inexpensive tools. Fire Proof, Frost Proof, Wind Proof. Material used—Cement and Sand or Gravel. Will supplant Wood and Iron entirely. For particulars write with stamp **A. D. MACKAY & CO.,** Commerce, Chicago.

3 MONTHS FREE

If you are interested in any kind of investment—Oil, Mining, Plantation, Industrial, Lands, Stocks, Bonds, Mortgages, etc., send us your name and address and we will send you The Investor's Review for three months free of charge. A journal of advice for investors. Gives latest and most reliable information concerning new enterprises. Knowledge is power. Great opportunities come and go. Great fakes likewise. Get posted before investing. Write today.

INVESTOR'S REVIEW, 1461 Gaff Bldg., CHICAGO, ILL.

WANTED Hardware novelties and other articles of merit. Must be good sellers. Will buy outright or sell on a royalty basis.

The Cleveland Sales Co.,
407 The Arcade - - - Cleveland, Ohio

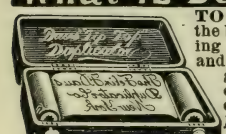
BE YOUR OWN BOSS

MANY MAKE $2,000 A YEAR

You have the same chance. Start a Mail Order Business at home. We tell you how. Money coming in daily. Enormous profits. Everything furnished, Write at once for our "Starter" and FREE particulars.

P. M. Krueger Co., 155 Washington St., Chicago, Ill

What Is Daus' Tip-Top?



TO PROVE that Daus' "Tip Top" is the best and simplest device for making **100 copies** from pen-written and **50 copies** from typewritten original, we will ship complete duplicator, cap size, **without deposit on ten (10) days' trial.**

Price $7.50 less trade discount of 33⅓%, or **$5 net**

THE FELIX S. K. DAUS DUPLICATOR CO.
Daus Building, 111 John St., New York City

I Turned Out $301.27

worth of plating in 2 weeks, writes M. L. Smith of Pa. (used small outfit). Rev. Geo. P. Crawford writes, made $7.00 first day. J. J. S. Mills, a farmer, writes, can easily make $5.00 day plating. Thos. Parker, school teacher 21 years, writes, "I made $9.80 profit one day, $9.35 another." Plating Business easily learned. **We Teach You Free—No Experience Required.** Everybody has tableware, watches, jewelry and metal goods to be plated with Gold, Silver, Nickel and Metal plating. **Heavy Plate**—latest process. No toy or humbug. Outfits all sizes. Everything guaranteed. **LET US START YOU.**

Write today for Catalogue, Agency and Offer. Address,
F. Gray & Co., Plating Works, Cincinnati, O.

Tools Every mechanic should have a copy of our large 600 page catalogue in his tool kit. The largest retail hardware stock in the world at your command. Everything for all trades at wholesale prices. We carry both the medium and the very best grades. Ask for 600 page Mechanics Catalogue. Free to any address. 10

Montgomery Ward & Co.
Michigan Ave., Madison and Washington Sts., Chicago

SOUVENIR WATCH CHARM, 10C., POSTPAID.

Peep into Charm and see St. Louis Exposition. Price 10c. each or 3 for 25c., postpaid. Our new catalogue of novelties, etc., free for asking.
W. H. MILLER SUPPLY CO., 738 E. 4th Street, St. Paul, Minn.

CANNED AMERICAN.

Burton Holmes, the lecturer, says that the Indians of Alaska regard white men and canned goods as so closely associated that they are nearly synonymous. Wherever the white man is seen canned meats, fruits and vegetables are found.

When Mr. Holmes visited Alaska recently he carried with him a phonograph, and it was exhibted to an old chief who had never seen a talking machine before. When the machine was started and the sound of a human voice came from the trumpet the Indian was much interested. He listened gravely for a time, then approached and peered into the trumpet.

When the machine finished its cylinder and stopped the Indian pointed at it, smiled an expansive smile, and remarked:

"Huh! Him canned white man."—Saturday Evening Post.

HOW TO KEEP BUTTER GOOD TWO YEARS.

It is said to be quite possible to preserve butter in such a manner that after a period of two years it will still be good and fine-tasting. Melt the butter in well-glazed earthen pans at a heat not exceeding 180 degrees Fahrenheit in a water bath, and keep it heated, skimming it from time to time, until the butter becomes quite transparent; then pour off the clear into another vessel and cool it as quickly as possible by surrounding it with cold water or ice.

Mix well together one ounce each of saltpeter and white sugar and two ounces of the best salt, all in very fine powder; then add one ounce of this mixture to every pound of butter and thoroughly incorporate them together. The butter thus prepared is then to be tightly pressed into clean glazed earthenware vessels, so as to have no vacant spaces. This butter does not taste well until it has stood for two or three weeks, after which it acquires a rich marrow flavor, which no other butter possesses. Any good, well-made fresh butter, free from butter-milk, will succeed by this method.

Dr. Evans, the American dentist, who achieved such success in Paris, once received, before he went abroad, a letter from a young Vermonter who wanted a set of false teeth made and sent to him. The letter concluded: "My mouth is three inches acrost, five-eighths inches threw the jaw. Some hummocky on the edge. Shaped like a hoss shew, toe forard. If you want me to be more particular I shall have to come thar."

Mike—Are ye much hurted, Pat? Do ye want a docthor?

Pat—A docthor, ye fule! After bein' runned over by a trolley car? Phwat oi want is a lawyer.

A Good Printing Outfit for 15c.

With it you can print your own cards, envelopes, or mark linen. Consists of 3 fonts rubber type, ink pad, type holder and tweezers. Price only 15c postpaid. Our new catalog of jewelry, novelties, etc., free for the asking.

DON'T MISS IT!

W. H. MILLER SUPPLY CO., 738 E. 4th St., St. Paul, Minn.

Please mention Popular Mechanics when writing advertisers.

THOUGHTS NOT LESE MAJESTE.

Two Irishmen serving in an English regiment were good chums until Rooney was raised to the rank of sergeant. Forthwith his chest expanded and from that time on he looked down on McGrane.

One day McGrane approached Rooney, and said: "Mike—I mean sergeant—s'pose a private stepped up to a sergeant and called him a conceited monkey, phwat wud happen?"

"He'd be put in the gyard-house."

"He wud?"

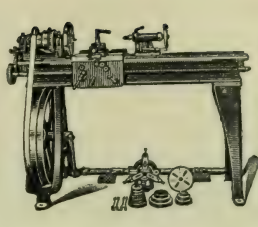
"He wud."

"Well, now s'pose the private only thought the sergeant was a conceited monkey and didn't say a wurd about it. Wud he be put in the gyard-house?"

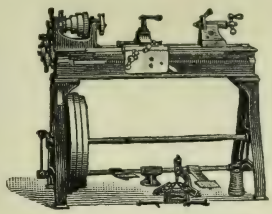
"Av coorse not."

"Well, then, we'll let it go at that."

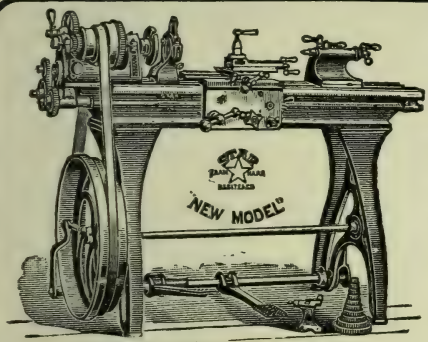
The whaling bark Josephine, of New Bedford, has obtained 1,200 barrels sperm oil and 500 barrels whale oil in less than a year's time. This is one of the richest cargoes reported in years.



B. F. BARNES'
ELEVEN-INCH SCREW CUTTING LATHE
For foot or power as wanted. Has power cross feed and compound rest. A strictly high-grade, modern tool. We also build a 9-inch lathe. Ask us for Catalog P.
B. F. BARNES COMPANY
Rockford - - Illinois



FOOT and POWER
LATHES
9 to 15 inch swing.
Built for service.
High Grade, Low Price
Accurate Tools
CATALOGUE FREE.
SEBASTIAN LATHE CO.
107-109 Culvert Street
CINCINNATI, O.



9 and 11-inch "Star" Foot Lathes.
9, 11, 12 and 14-inch "Star" Power Lathes

STAR LATHES Foot and Power...

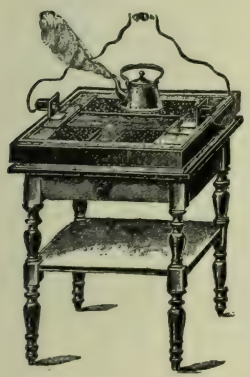
High-grade screw-cutting engine Lathes, with forged crucible steel hollow spindles, phosphor bronze bearings, gear-driven reversible feeds with strong friction drive in apron, our patented spring nuts which allow quick shifts of change gears, also Draw-In Chuck, Gear-cutting, Milling and Taper Attachments if desired.

Suitable for electrical and repair work, model makers, gunsmiths, technical schools and fine, accurate machine-shop and tool-room service. Ask for COMPLETE DESCRIPTIONS.

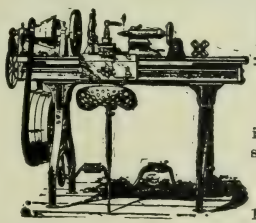
THE SENECA FALLS MFG. CO.
102 WATER STREET, SENECA FALLS, N. Y., U. S. A.

KRYPTOL—THE "BURNLESS FUEL."

A German scientist has invented a substance with which one can cook or heat a house, but is not consumed. He calls it Kryptol, which is composed of graphite, clay and carborundum combined by a secret process. When a strong current of electricity is passed through a mass of Kryptol it becomes white hot and will boil water in three minutes. The amount of heat can be regulated by changing the strength of the electric current, or by altering the thickness of the layer of Kryptol, which in a cooking range is contained in square earthenware pans placed on a table. The substance is in grains which are spread to the depth of one inch; it is expected to last indefinitely. The Kryptol is not expensive, but the system costs a great deal more to operate than where gas or coal is used for the same purpose.



FOOT and POWER
AND TURRET LATHES, PLANERS
SHAPERS AND DRILL PRESSES ::::
SHEPARD LATHE CO.
A131 W. 2d St., Cincinnati, Ohio



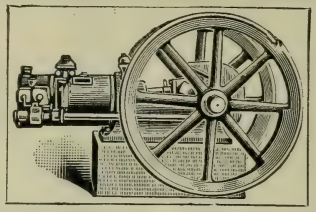
LATHES
9 to 13 inch Swing
List price, $65.00 and up according to size. When ready to buy send for Lathe Catalog and prices
W. F. & John Barnes Co.
100 Ruby St., : : Rockford, Ill.

Send three one-cent stamps for 5-color PICTURE OF LINCOLN PARK BRIDGE
W. L. STEBBINGS
Civil and Consulting Engineer
LICENSED ARCHITECT
Monadnock Block, - - - Chicago
Tel. Harrison 1104 Cable Address "Stebbings" Directory Code

The "OTTO" Still in the Lead

It is not surprising that the "OTTO" was awarded the Gold Medal at St. Louis. In fact it has never failed to take first prize wherever exhibited. Below is a list of the "OTTO" triumphs in America:

Philadelphia Centennial, 1876
New York, 1880
Cincinnati, 1880
New York, 1881
Louisville, 1883
San Francisco, 1884
New York, 1885
New Orleans, 1885
Buffalo (Pan-American), 1901



Chicago World's Fair, 1893
Atlanta, 1895
New York, 1896
Nashville, 1896
New York, 1897
Omaha, 1898
Omaha, 1899
Philadelphia, 1899
St. Louis (Louisana Purchase Exposition) 1904

No engine could be uniformly successful without deserving it.

THE OTTO GAS ENGINE WORKS, Philadelphia, Pa.

CHICAGO: 360 Dearborn Street MINNEAPOLIS: 318 3d Street OMAHA: 1108 Farnam Street

The New
Popular Mechanics
PREMIUM LIST

Fully Illustrated
Is Now Ready

BOOKS FOR MECHANICS,
ELECTRICIANS, ENGINEERS
SHOP TOOLS OF ALL KINDS
SPORTING GOODS, WATCHES, ETC.

Something for everybody given for one or more new subscribers.

ADDRESS

Popular Mechanics
JOURNAL BUILDING, CHICAGO

Run It Yourself

You can quickly learn to run steam engines by studying

Young Engineer's Guide.

Save the expense of hiring an engineer. Book recently revised to 254 pages. Illustrated. Endorsed by engine manufacturers and leading engineers everywhere. Price, bound in best leather, $1.25; Cloth, $1.00. Address

J. V. ROHAN, Box 20 Racine, Wis.

Free sample cards

The "Jonah" Smile fits any face **Jonah** suits any crowd. Best game for **any** number—only good game for two **Jonah Solitaire**—fascinating game for one player. **A hit. If you entertain,** can't afford to miss **Progressive Jonah. "Stocks"** Jolliest Stock Exchange Game—new—different—better—price, **50c.** Send **50c** and address 6 people who play games and we'll send a combination pack with cards so **2** to **6** can play all above games. Money back if **you** say so—no conditions. Cards are such good value not 1 in 1,000 come back. Makes you safe—saves time Jonah Game Works, Suite 3862, ROBEY St. Chicago

TAXOMETERS COMPUTE CAB FARES.

In Paris and in several other large continental cities an instrument called a taxometer is used to determine the amount of cab fare a passenger must pay according to the distance traveled, or, if he wishes to go at a rate slower than five miles, and during stops the amount is reckoned by time occupied.

When one enters a cab the driver lowers to a horizontal position a small metallic flag bearing the word free and the taxometer, which in the beginning is set at 7.5 centimes (14.475 cents), immediately begins to work. The figures remain the same for the first 1,300 yards, after which 10 centimes (1.93 cents) are added for each additional 430 yards. A dial below set at 25 centimes (4.825 cents) computes the charge for packages. When the passenger pays, the driver again raises the flag to a vertical position and all figures are effaced. The rate by time is 10 centimes (1.93 cents) for three minutes. The driver sets the time mechanism, but as soon as the rate increases to more than five miles an hour the apparatus adjusts itself automatically and records by time.

SOLD $20 WORTH OF PAINT FOR $1,000.

A captain on one of the ferry boats plying in New York harbor tells the following story of the value of a coat of paint:

"Some years ago I owned a small sailing vessel engaged in the coast and West Indian trade. While we were lying at an East River pier taking on a cargo for the West Indies, a stranger approached, and, after critically eyeing my craft, asked:

" 'What'll you take for that boat?'

" 'One thousand eight hundred will buy her,' I told him.

" 'I'll give you thirteen hundred,' replied the stranger. 'She's an old boat, and not worth any more.'

"I refused his offer, and he soon disappeared, but I made up my mind that I would spend a little money for white lead and oil, and when I was lying in port unloading the cargo I would have my men paint up the boat and improve her appearance. When I sailed into port again she looked as good as new. After reaching the pier I saw the same fellow walking about, looking the craft over. Soon he approached me and asked:

" 'Excuse me, sir, how much will you sell her for?'

" 'You can have her for $2,500,' I told him.

" 'Call it $2,300 and I'll take her,' he replied, and it didn't take me long to accept the offer. I calculated I made a thousand on $20 worth of paint."

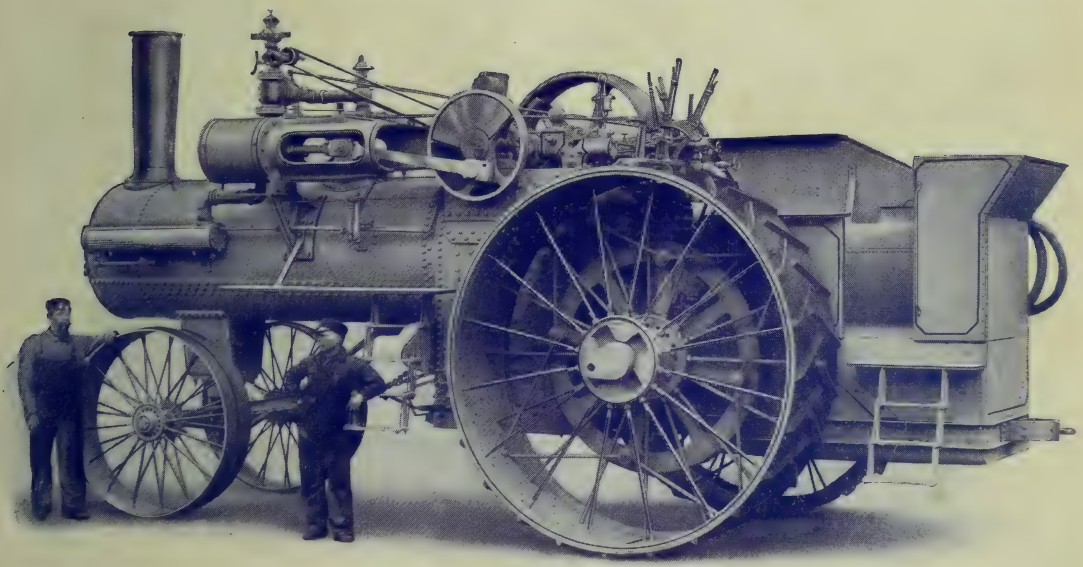
LARGEST CIRCULATION OF ANY MECHANICAL PUBLICATION IN THE WORLD

$1. per year DECEMBER 10 Cents

POPULAR MECHANICS

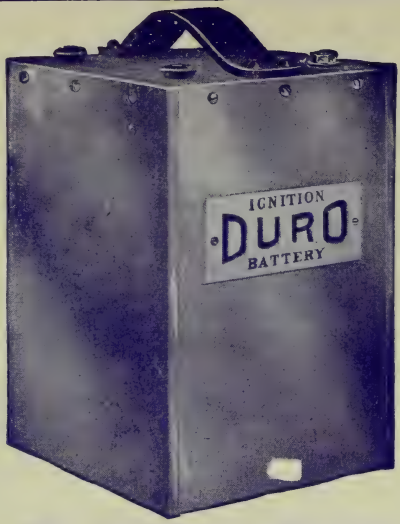
WRITTEN SO YOU CAN UNDERSTAND IT

Monster Road Locomotive Which Requires No Tracks



The Road Locomotive is the Outgrowth of the Modest Traction Engine of a Few Years Ago. This Machine on Fairly Good Roads will Haul 50 Tons up a 10 per cent Grade. **For Description see Page 1210.**

THE TRUTH ABOUT THE AIR-SHIP ---- Pages 1201-1208



WE CAN KILL THOSE

IGNITION TROUBLES

DURO BATTERIES ARE THE MOST DURABLE, COMPACT and EFFICIENT

The Only Way of Obtaining a Mileage Guarantee

Chicago Battery Co.

1421 Michigan Avenue, Chicago

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed.* Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

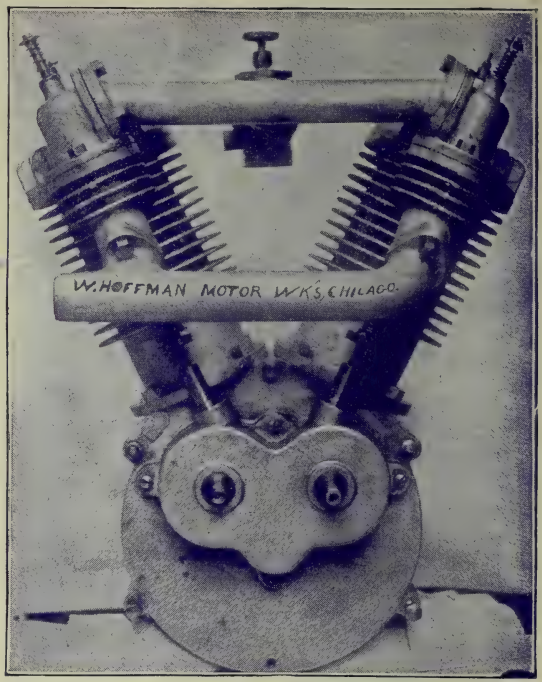
CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

2-CYLINDER
5-HORSE POWER

BICYCLE ENGINE



Auto, Marine and Bicycle Engines—Also Castings for Same.

W. HOFFMAN MOTOR WKS., 1251 N. Halsted St., Chicago

The American Well Wks.

AURORA, ILL., U. S. A.

CHICAGO, ILL. **DALLAS, TEX**

For over a quarter of a century have been building WELL SINKING and PROSPECTING MACHINERY and TOOLS for ROCK and ALLUVIAL, ROTARY and CORING WORK of moderate cost, speedy economical in operation, enabling large per cent saving in pay roll and pipe bills.

This photograph may not illustrate the style of machine best suited to your work, but we have one hundred other styles and sizes some of which will. Why should we not have your orders?

We have pleased old customers, can please new ones.

POPULAR MECHANCS

"Written So You Can Understand It."

PUB. BY POPULAR MECHANICS CO.
Journal Bldg.

CHICAGO

SUBSCRIPTION $1.00 PER YEAR
Foreign Countries $1.50

A Monthly Magazine. Entered at the Chicago Postoffice as Mail Matter of the Second Class.

VOL. VI. CONTENTS FOR DECEMBER, 1904 NO. 12

THE TRUTH ABOUT THE FLYING-MACHINE 1201
Photographed the Peaks of the Alps from a Balloon 1205
FRENCH AERIAL CRAFT HAS SOME STRANGE NEW FEATURES.....1205
AIRSHIP CONTESTS AT ST. LOUIS.....1206
THE "CUMBERLAND"—NEW TRAINING SHIP FOR AMERICAN JACKIES....1209
The "Overland" Mail in Thibet.....1209
Bridge Building in the Philippines.....1210
ROAD LOCOMOTIVES 1210
THE METEOR AUTO, A FRENCH AMUSEMENT DEVICE 1211
HEAVIEST AND MOST POWERFUL LOCOMOTIVE EVER BUILT.....1212
SUNKEN TREASURE OF OLD SPANISH GALLEONS TO BE RAISED BY COMPRESSED AIR 1213
United States Battleships Now Under Construction 1214
Wire Rope Made by the Romans 1,800 Years Ago 1214
FORECASTING SHIP SPEED AND ACTION 1215
Liquid Fuel Pumped to Battleship While in Motion 1217
$10,000 for Winner of Ocean Race.....1217
Instrument Photographs the Interior of the Human Eye 1218
American-Built Submarine Boats for Japan..1218
AERIAL TRANSPORTATION 1219
Opened a Bank Vault by Electricity.....1224
Latest Football Armor.....1224
BUCKET TRAMWAY IN MOUNTAINS OF WASHINGTON.....1225
Combination Locomotive Car.....1226
Electric vs. Steam Locomotive.....1226
Oil Production the Past Year.....1226
"BENDS" OR THE CAISSON DISEASE..1227
TALL BETON AND STEEL LIGHT-HOUSE ERECTED BY RUSSIAN GOVERNMENT 1229
Best Flour from Mixed Wheat.....1230
A Desk for a Child.....1230
High Speed Requires Single Cars.....1230
Goats on Arizona Ranges.....1231
Automobile School for Horses.....1231
First Automobile in the United States.....1232
Piece of Water Main Used in New York City 107 Years Ago.....1232
THE GAS ENGINE ON THE FARM.....1233
Surgeon's Acetylene Headlight for Operating at Night 1234
ELECTROGRAPHY: A COMPANION TO PHOTOGRAPHY 1251
MECHANICS FOR YOUNG AMERICA—
How to Make "Antique" Clocks from "Up-to-Date" Materials 1252
Lettering a Clock Dial.....1254
How a Boy Built a Steam Engine with Few Tools 1254
Focusing Screens 1254

SHOP NOTES.

How to Make a Steam Trap.....1235
How to Straighten Paper.....1235
Formula for White Metal.....1235
Proper Method of Bending Lead Pipe.....1236
How to Make a Grease Cup.....1237
Wants to Remove Broken Firing Pin.....1237
How to Shape Carriage Springs.....1237
Recipe for Marine Glue.....1238
To Use Wrench as Hand Vise.....1238
Melting Brass in an Oil Furnace.....1238
Paste for Dry Battery.....1239
Chaser for Cutting Threads.....1239
Heavy Screw Drivers.....1239
How to Make a Torch of Pipe.....1239
A Good Soldering Fluid.....1239
Taking Out Bruises in Furniture.....1239
Angling for a Foot-Valve.....1240
Removing Lime in Water Jacket.....1240
Life of Cast-Iron Pipe.....1240
A Simple Tempering Recipe.....1240
To Revive from Suffocation.....1240
How to Make a Gravel Roof.....1241
Hot Water for Barber Shops.....1241
How to Darken Oak.....1241
How to Make a Cheese Press.....1242
How to Make Phosphor Tin.....1243
Human Clamps 1243
How to Make a Handy Key-Seating Tool..1244
How to Recognize a Good Quality of Glue..1244
Putting Plugs in Water Pipes.....1244
Removing Glass Stoppers.....1244
Emergency Rope Tire for Automobiles.....1245
Re-arranging Heating Coils.....1245
A Simple Instrument for Aligning Engines..1246
Bulging Putty 1246
Improving a Hammer Handle.....1246
Thawing Service Pipe by Electricity.....1247
Covering for Overhead Steam Pipes.....1248
Cleaning Boiler Tubes.....1248
Largest Steel-Concrete Chimney in the World.1249
To Loosen Rusty Screw.....1249
How to Soften Putty.....1249
How to Clean Polished Oak.....1249
Worn Valve Gear and How to Deal with It.1250

Diamonds
On Credit

One-Quarter Carat Quality A 1 — **$32.00** — $6.00 Down $3.00 Per Month

CHRISTMAS SPECIALS

One-Half Carat Quality A 1 — **$65.00** — $10.00 Down $6.00 Per Month

Upon request, we will express either one of the rings above shown, to any honest person, for inspection, all charges paid. **ORDER AT ONCE.** Don't wait until the eleventh hour. Last Christmas many were disappointed because they ordered too late. You may safely send first payment with order, or if you prefer, we will send goods on approval, C. O. D. first payment, balance to be paid as per terms indicated. We sell Watches the same way Catalog No. P 161 sent FREE.

HERBERT L. JOSEPH & CO.
DIAMOND MERCHANTS
JEWELRY MANUFACTURERS
148 P 161 State Street, CHICAGO
Responsibility $250,000 Established 1882

LETTERING

A neat booklet, now ready, contains many good things for students

PRICE, 25 CENTS

DRAFTSMEN, DESIGNERS, ARCHITECTS,

need our new book on dimensions of

Pipe, Fittings and Valves

NO BOOK LIKE IT

FLEXIBLE CLOTH BACKS, 50 CENTS.

HAVE YOU SEEN A COPY OF

THE DRAFTSMAN?

It is a neat monthly magazine on DRAFTING and Home Study.

$1.00 PER YEAR. 4 MONTHS TRIAL, 25c.
or the Magazine and "Lettering" for $1.00

ADDRESS

THE DRAFTSMAN, Cleveland, O.

Your Library

Is not complete if it does not contain the following histories in some form. We have a limited number of sets which we secured in a Remainder Lot Sale, and which we will offer while they last at ridiculously low prices. The books are bound in red buckram, printed in good type on good paper and have gilt tops.

LIST	Publisher's price.	Sale price.
Guizot's France, 8 vols	$12.00	$5.00
Gibbon s Rome, 6 vols	9.00	3.50
Wilkinson's Egypt, 2 vols	3.00	1.50
Prescott's Mexico, 2 vols	3.00	1.00
Prescott's Peru, 2 vols	3 00	1.00
Green's England, 4 vols	6.00	3.50
Lewis' Germany, 2 vols	3.00	1.25
Griffis' Japan, 2 vols	2.00	1.50
Hildreth's U. S., 6 vols	9.00	3.00
Grote's Greece, 12 vols	18.00	6.00

Although these prices do not include express charges, yet if they are not satisfactory to you they may be returned at our expense and we will refund the express charges which you are obliged to pay. If you are interested we would advise your ordering at once so as to be sure of securing the books.

CUT COUPON HERE

The Pilgrim Press CHICAGO

Send on approval as advertised in Popular Mechanics, 1 set each

If satisfactory will send the amount within 30 days. If not will return within 5 days.

Name _____

Address _____

Fill out coupon attached and send to-day to **The Pilgrim Press** 175 Wabash Ave. CHICAGO

NOTICE

TO LOCAL SUBSCRIPTION REPRESENTATIVES OF

POPULAR MECHANICS £2

You are expected to keep track of your subscribers and secure their renewal and forward same to the home office not later than the first of the month in which the subscription expires. Failing to do this we will then notify the subscriber direct from this office, but will recommend he hand the renewal to you to be forwarded £2 £2

Popular Mechanics

WANTED! WANTED! WANTED!

Chief Electricians. Chief Engineers. Assistants. Salary from $900 to $1,800 per year

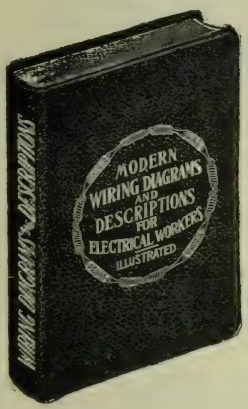
The men that land these kind of jobs are men who study Practical Books; men who study during off hours. To get this Practical knowledge, you must read Books written by Practical men, men who are employed daily in their particular line. The one Cardinal Principle of Frederick J. Drake & Company in publishing books is never to accept manuscript, no matter of what merit, from college professors. Every book bearing our imprint has been written by a Practical Mechanic, and is strictly NONTECHNICAL. Our books are accurate, up-to-date, plain language, complete, representing the best that brains and money can produce.

The Most Important Book on Electrical Construction Work For Electrical Workers Ever Published.

NEW 1904 EDITION

MODERN WIRING

Diagrams and Descriptions



A Handbook of practical diagrams and information for Electrical Workers.

By HENRY C. HORSTMANN and VICTOR H. TOUSLEY.

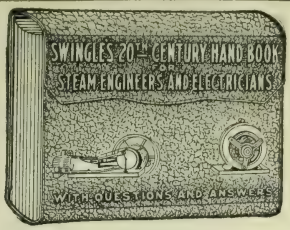
This grand little volume not only tells you how to do it, but it shows you.

The book contains no pictures of bells, batteries or other fittings; you can see those anywhere.

It contains no Fire Underwriters' rules; you can get those free anywhere.

It contains no elementary considerations; you are supposed to know what an ampere, a volt or a "short circuit" is. And it contains no historical matter.

All of these have been omitted to make room for "diagrams and descriptions" of just such a character as workers need. We claim to give all that ordinary electrical workers need and nothing that they do not need. 16mo, 160 pages, 200 illustrations; full leather binding, round corners, red edges. Size, 4x6, pocket edition, price $1.50.



The 20th CENTURY HANDBOOK FOR STEAM ENGINEERS AND ELECTRICIANS

With questions and answers by C. E. Swingle, M. E. This is the very latest and best book on Engineering and Electricity for the beginner, practical engineer or electrician published. It is written in purely self-educational style, so that any one with but a limited education can understand it. Illustrated with hundreds of fine engravings showing every working part of the engine or boiler, dynamo, etc. 500 pages, 300 illustrations, size, 5x7, durably bound in full leather, pocket style, gold edges, price $2.50.

ELECTRICITY MADE SIMPLE

By Clark Caryl Haskins.

There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it, and at the same time, not written in a childish manner. For engineers, dynamo men, firemen, linemen, wiremen, and learners. For study or reference. 12mo, cloth, 220 pages, 160 illustrations, price, net, $1.00.

MODERN AIR BRAKE PRACTICE, Its Use and Abuse

By Frank H. DuKesmith

The new Air Brake Book. Invaluable to Trainmen, Engineers, Firemen, Conductors, Electric Motormen, and Mechanics. The latest and best 1904 edition. With questions and answers for Locomotive Engineers and Electric Motormen.

You may have read many air brake books, but whether you have or not, you cannot afford to be without the benefits contained in this volume if you have anything whatever to do with the operation or maintenance of air brakes.

The book is fully indexed and cross-indexed, so that any subject can be turned to immediately, as desired.

If you are already posted, you can become better posted. If you really want to know all that is worth knowing about air brake practice send for this book.

12mo, Cloth, 303 pages. Price, $1.50

We return your money, paying all expenses involved to and from your home, if our Books are not as represented. Our complete catalogue sent FREE on request.

Frederick J. Drake & Co.,

Publishers of Self-Educational Books for Mechanics for Home Study.

211-213 East Madison Street (Mechanical Dept.) CHICAGO

MORE MONEY

is made from Patents than from any other class of Investments. . .

SUCCESS SURE

IF YOU HAVE A GOOD INVENTION BACKED BY A STRONG PATENT AND BUSINESS ABILITY.

THE FIRST STEP

If you have made an invention and contemplate applying for a patent, the first point is to learn whether your idea is new and patentable. Do not depend on the fact that you or your friends have never seen anything of the kind. Send us a pencil drawing, showing plainly your invention, and write out a description of its construction and operation, as well as you can. If you have a model, send it instead of the drawing. We will compare your sketch or model with all patents issued in the United States for inventions resembling yours, and for inventions in which similar mechanical constructions or principles are used. If a patent is found for an invention exactly like or closely resembling your idea, we will send you a copy of such a patent. If nothing is discovered to prevent getting a patent for your invention we will so advise you.

The charge for this service, unless otherwise agreed upon by special arrangement, is five dollars. This examination is an important step in connection with every patent application and requires great care and skill. An incompetent attorney may overlook a patent which closely resembles or completely anticipates your invention, or he may not know where to look. A dishonest attorney will purposely fail to find an anticipating patent in order that he may get the fee for preparing the application. The inventor is the loser in either case.

WHAT A PATENT COSTS

Opinion as to novelty and patentability of an invention, *after thorough examination* of United States patents	$ 5.00
Preparing official drawing—one sheet	5.00
Preparing Oath, Petition, Specification and Claims	15.00
First Government Fee	15.00
Prosecuting application for patent	10.00
Total cost of application, first Government fee, official drawing, preparing all papers and prosecuting application in Patent Office	45.00
Within six months after the application has been allowed, the Government charges a final fee of	20.00
Thus the total cost of a patent for a simple invention is	65.00

Intricate inventions cost more to patent, but we will state the exact cost in advance in each case. We assist our clients in selling and promoting their patents without advance charges.

POPULAR MECHANICS PATENT BUREAU

Main Office: Journal Building, Chicago, Illinois

Associate Offices: WASHINGTON, D. C., LONDON, BERLIN and other large cities.

RICHARDSON ENGINEERING CO.

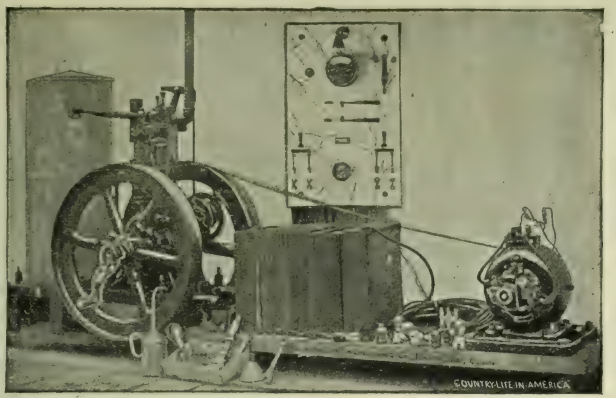
ELECTRIC LIGHTS

36 PEARL STREET HARTFORD, CONN. U.S.A.

SIMPLE
RELIABLE
PRACTICAL

No Electrician Needed to Install or Operate

Large Outfits for Any Size Place, Launch or Yacht



ALL OUR OUTFITS COMPLETE IN EVERY DETAIL

Very Best Material Used

Light all the Time as Every Outfit Includes a Storage Battery

NO. 3. 20-LIGHT OUTFIT FOR MOUNTAIN AND SHORE

COTTAGES OR SMALL HOMES, $450, EVERYTHING INCLUDED. OTHER SIZES TO $1,800

THE GAS, GASOLINE OR STEAM ENGINES FURNISHED GIVE PLENTY OF POWER FOR SAWING WOOD, PUMPIMG WATER, REFRIGERATION, ICE MAKING, ETC.

FOR INTERESTING AND VALUABLE PRINTED MATTER, ADDRESS

Electric Light Dept. **RICHARDSON ENGINEERING CO.,** Hartford, Conn.

The Overland Limited

California

the most luxurious train in the world, leaves Chicago 8:00 p. m. daily. Less than three days to San Francisco, Magnificent equipment. Electric lighted throughout.

THE BEST of EVERYTHING

Two other fast trains leave Chicago 10 a.m. and 11:35 p. m. daily, with through service to San Francisco, Los Angeles and Portland via the

Chicago & North-Western, Union Pacific and Southern Pacific Railways

All agents sell tickets via this route.
Illustrated booklets on application to
W. B. KNISKERN, CHICAGO, ILL.
or E. L. LOMAX, OMAHA, NEB.

OL16

INDUSTRIES
ARE
OFFERED
LOCATIONS
WITH

Satisfactory Inducements
Favorable Freight Rates
Good Labor Conditions
Healthful Communities

ON THE LINES OF

THE ILLINOIS CENTRAL R. R.
AND THE
YAZOO & MISSISSIPPI VALLEY R. R.

For full information and descriptive pamphlet, address

J. C. CLAIR
Industrial Commissioner
1 Park Row, - - - Chicago, Ill.

DIAMONDS ON CREDIT

YOU MAY SELECT

any one of these beautiful Genuine Diamond pieces shown here at $50.00; send $10.00 and we will send it on approval; or if you prefer, you may pay the $10.00 on delivery after you have seen and examined the article

THE balance you may send us at the rate of $5.00 per month. Illustrations shown here are late patterns. Each Diamond is carefully selected, is pure white in color and perfect—**EVERY STONE IS A GEM.** Now is a good time to start and save for your Christmas Gift. Any honest person can open an account with us, regardless of their financial worth. We pay all express charges whether you buy or not; give a written guarantee with every Diamond, and allow full original price whenever you want to exchange for other goods or a larger Diamond. We give your orders prompt attention and guarantee perfect satisfaction or your money back. We refer you to Pan-American Banking Co., capital $500,000.00. Write today.

Marquardt & Scott Co., Diamonds, Watches, Jewelry

DEPT. 155

126-128-130 State St., Chicago.

"The World's Best Music"

ABSOLUTELY FREE for five days' examination

If there is a piano in your home, you are constantly buying sheet music—and paying high prices for it. It lies in ragged piles around the house and becomes scattered and torn. You lose money by buying music in that way, to say nothing of your loss of time and temper when searching for a particular selection. Why not buy your music in volumes filled with the best selections, and thoroughly indexed? The **"Library of the World's Best Music"** is designed for your needs. Its eight volumes—sheet music size, but light and easy to handle—are crowded with the best vocal and instrumental music, carefully selected by an experienced corps of music editors. If you were to buy the music it contains, one piece at a time, **it would cost you over $200.00.** Through our Musical Library Club—for a limited time—the entire set will cost you one-tenth of that amount and you can pay in

Little Monthly Payments

"The World's Best Music" is complete in **eight large volumes** (four vocal and four instrumental), 9 x 12 inches in size, attractively bound in half-leather or cloth. By means of an ingenious device in binding, the volumes open flat at the piano and remain open. A set contains over 400 illustrations; including numerous chromatic art plates, printed in ten to twelve colors. There are **2,200 pages of sheet music** in the entire library.

IF YOU ARE A PIANIST you will find this collection of music invaluable. It contains **300 instrumental selections** by the best composers, including popular and operatic melodies, dances, funeral marches, and classic and romantic piano music. Such composers are represented as Paderewski, Gounod, Sullivan, Mascagni, Wagner, Mozart, Balfe, and Liszt.

IF YOU LIKE MUSIC but do not play yourself, you cannot make a better present to your wife or daughter than a set of this Musical Library. It means evening after evening of pleasure, for it furnishes in the most compact and simple form all the world's greatest music. This collection is to music what the encyclopedia is to knowledge—the best of all properly proportioned.

IF YOU ARE A SINGER the "World's Best Music" will increase your repertoire. It will place in your hands **300 of the best old and new songs,** duets, trios, and quartets, arranged for all voices and for piano accompaniment. The collection embraces all the old songs of your childhood days, besides the new and popular melodies of the last few years.

IF YOU ARE A STUDENT of music, you will find this Library more than half a musical education. The selections have been made by Reginald DeKoven, Victor Herbert, Helen Kendrick Johnson, Gerrit Smith, and others equally well known in the musical world. As a musical cyclopedia it is unexcelled, as it contains **500 biographies of musicians and 400 portraits.**

The Coupon Cuts the Price in Two!

Our Musical Library Club has secured an entirely new edition of the "World's Best Music" at a price slightly above the cost of paper and printing. On this account we are able to offer these sets at about one-half the regular subscription prices—**payable $2.00 a month.** Through the Musical Library Club—direct from the publisher to the customer—you can secure a set for **$21.00 in cloth binding** and **$25.00 for the half-leather.** These sets were previously sold for $35.00 and $40.00. The edition is small, so to avoid possible disappointment in failing to secure a set, cut off the coupon to-day, sign it, and mail it to us. We will then send you a set **(express paid by us)** for examination and use. After five days' examination, if you are not satisfied, return the books to us at our expense. But if you decide to keep the set, send us $1.00 at the expiration of five days, and $2.00 a month thereafter until the full amount is paid.

What MARGARET E. SANGSTER says:

"I have seldom seen anything so well worth having in one's home. I have lingered over each part with peculiar pleasure, and have no hesitation in saying that you have made a collection of great value, both in the music, and in the artistic and biographical features."

The Riverside Publishing Co.
204 Dearborn St., Chicago, Ill.

CUT OFF AND MAIL THIS COUPON

THE RIVERSIDE PUBLISHING COMPANY
P. M. Chicago, Ill.

Please send me for inspection a set of **"The World's Best Music,"** in half-leather, at no expense or obligation on my part. If I retain same, I will send you $1.00 within 5 days and $2.00 per month thereafter for 12 months.

Name.....

Street.....

City.....

In ordering cloth, change 12 months to 10 months.

Investments

for funds of all sizes from $500 up and netting from 5 per cent to 6 per cent, may be safely made in

Bonds

issued under our serial plan whereby the debt is steadily reduced and the margin of safety increased, and in our

Mortgages

on improved income-producing Chicago real estate in selected locations.

Send for our Current Lists

PEABODY, HOUGHTELING & CO.

1122 First National Bank Bldg.

CHICAGO

(ESTABLISHED 1865)

Have You Ever Considered the

Practical Results

of a Savings Account in

THE SAVINGS DEPARTMENT

of

THE NORTHERN TRUST COMPANY BANK

SOUTHEAST COR. LA SALLE AND ADAMS STS. CHICAGO

CAPITAL $1,000,000 - SURPLUS $1,000,000

COMPUTATIONS SHOWING ACCUMULATIONS OF MONTHLY SAVINGS DEPOSITS

OF ONE TO TWENTY DOLLARS IN ONE TO FIVE YEARS, WHEN INTEREST IS COMPOUNDED SEMI-ANNUALLY AT 3% PER ANNUM

Monthly Deposit	1 Year	2 Years	3 Years	4 Years	5 Years
$1	12.19	24.75	37.67	51 00	64 72
$2	24.39	49.50	75.37	102.03	129.49
$3	36.58	74.25	113.08	153 06	194.26
$4	48 78	99.01	150.79	204 11	259.06
$5	60.97	123.78	188.47	255.13	323.81
$6	73.17	148.54	226.20	306.19	388.62
$7	85.36	173.29	263.90	357.22	453 37
$8	97.56	198.06	301.60	408.26	518.15
$9	109.75	222.81	339.28	459.28	582.91
$10	121.95	247.57	376.99	510.33	647.70
$11	134.14	272.33	414.70	561.37	712.47
$12	146.34	297.10	452.43	612.43	777.28
$13	158.53	321.85	490 11	663.47	842.06
$14	170.73	346.62	527.82	714.49	906.81
$15	182.92	371.37	565.51	765.52	971.57
$16	195.12	396.13	603.22	816.58	1036.38
$17	207.31	420.90	640.93	867.61	1101.14
$18	219.51	445.65	678.62	918.64	1165.91
$19	231.70	470.41	716.33	969.70	1230.70
$20	243.91	495.18	754.05	1020.75	1295.50

Copyrighted 1904, The Northern Trust Co.

Saving Accounts may be opened with one dollar or more, If not convenient to come to the bank, write for booklet, "Banking by Mail."

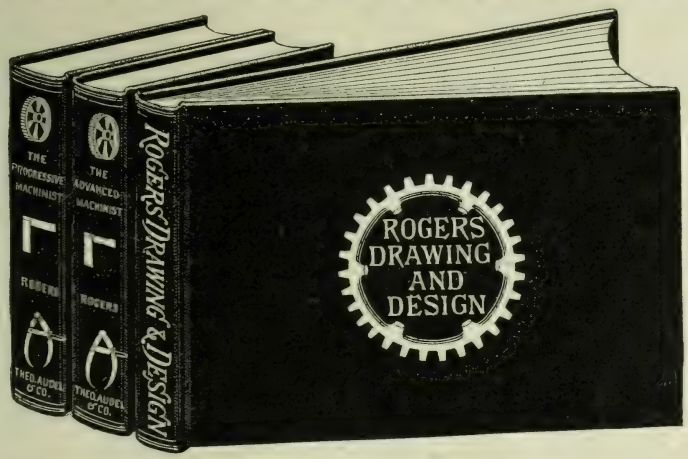
DIRECTORS

A. C. BARTLETT, of Hibbard, Spencer, Bartlett & Co.
J. HARLEY BRADLEY, of David Bradley Mfg. Company.
WILLIAM A. FULLER, formerly of Palmer, Fuller & Co.
MARVIN HUGHITT, President Chicago & N. W. Ry. Co.
CHAS. L. HUTCHINSON, Vice-Pres. Corn Exch. Nat'l Bk.
MARTIN A. RYERSON,
ALBERT A. SPRAGUE, of Sprague, Warner & Company.
BYRON L. SMITH, President The Northern Trust Company.

ROGERS' MACHINISTS' LIBRARY LIST

The Progressive Machinist - $2.00
The Advanced Machinist - 2.00
Mechanical Drawing and Design, 3.00

SEND POSTAL FOR MACHINISTS' CATALOGUE



Each of the books in the Library is a complete treatise in itself and can be purchased separately at price above named

PLAN OF WORK

The three volumes composing the "Machinists' Library" have been issued just long enough to receive the most hearty approval of the best representatives of the Engineering and Mechanical world.

The books composing the library are intended to be: educational, and progressing from the simple to the more complex subjects; plain books for those already engaged, or soon to be, in the practical application of the theory of mechanics; each volume is complete in itself, while progressive in the series. The books are each supplied with a ready reference index, which enables the quick use of their contents.

The volumes are strongly and handsomely bound in black cloth, with titles and edges in gold; they contain 1,204 pages, 1,244 illustrations, many of which are full pages, with 3,000 ready references; they are printed on fine surface paper with large, clear type. Each book stands 8½ inches in height, and the three packed for shipment weigh over 7½ lbs. No works of equal value have ever been offered to the machinists' and allied trades, and no one, from the Superintendent and Owner to the Apprentice, can afford, considering the price and terms, to be without them.

MONTHLY PAYMENT PLAN

Roger's Library is supplied whenever desired on easy terms. Upon receipt of one dollar, and agreement to remit the same amount each month for six months, and accompanied by the name of one or two persons of whom inquiry could be made if desired, regarding subscriber's reputation for keeping business promises, the set will be shipped to any part of the world with all transportation charges prepaid.

CUT OUT AND MAIL TO-DAY

I accept your offer to supply me with Rogers' Machinists' Library (3 vols.) for $7. Enclosed find $1 as first payment; the balance I agree to remit in $1 monthly installments.

NAME .....

OCCUPATION .....

ADDRESS .....

You are at liberty to consult the person named below as to my reputation for for keeping business promises.

NAME .....

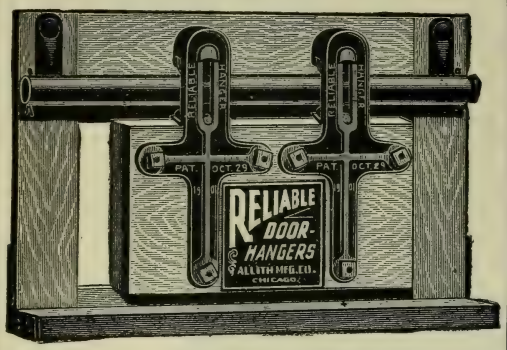
ADDRESS .....

Popular Mechanics, Dec., '04.

THEO. AUDEL & CO., Educational Book Publishers

63 FIFTH AVENUE NEW YORK

THE "RELIABLE ROUND TRACK DOOR HANGER"



You know how the old-fashioned Door-Hanger sticks
Ours Will Not Bind
Ours Cannot be Derailed

Let Us Tell You About It

WRITE FOR CATALOG AND PRICES

ALLITH MANUFACTURING CO.

120 South Green Street, Chicago

SAVE MONEY! GET SECURITY! HOW?

By Installing A

Holtzer Watchman's Clock

Many a watchman has caught a blaze like this when on his rounds ringing in on a Holtzer Watchman's Clock.

It Reduces Your Insurance Rate | ***It May Save Your Factory***

Do not wait until the fire catches you but write us to-day. Let us tell you all about it. **Ask for bulletin No. 1152.**

Holtzer-Cabot Electric Company

New York **395 Dearborn St., Chicago** **Brookline, Mass.**

A COMPLETE LIBRARY OF ENGINEERING FOR $3.50

If you wish to be promoted or hold a position of trust, this grand book will be a wonderful help to you.

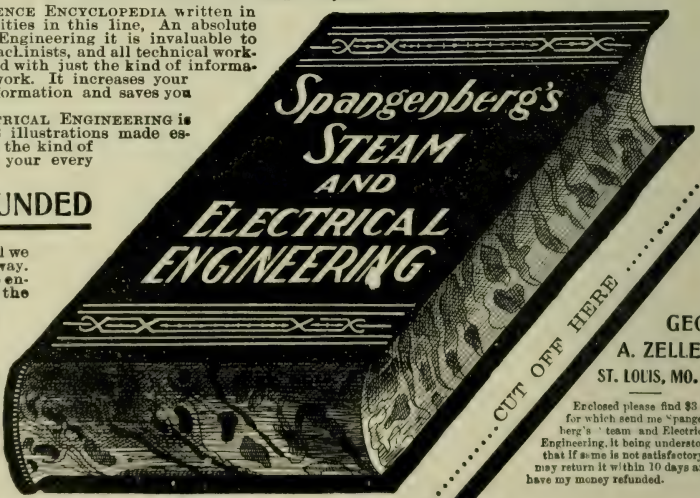
A THOROUGHLY PRACTICAL REFERENCE ENCYCLOPEDIA written in plain direct style by the best authorities in this line, An absolute authority on Steam and Electrical Engineering it is invaluable to Engineers, Firemen, Electricians, Machinists, and all technical workers. From cover to cover it is packed with just the kind of information you need in your every day work. It increases your ability, gives you a wider range of information and saves you time.

SPANGENBERG'S STEAM AND ELECTRICAL ENGINEERING is bound in cloth, contains 672 pages, 648 illustrations made especially for this book and 1035 of just the kind of questions and answers that arise in your every day work.

YOUR MONEY REFUNDED

—and cheerfully—if the book is not all we claim for it and satisfactory in every way. The edition is limited. Fill out the enclosed coupon and mail today and if the book is not perfectly satisfactory, return it in 10 days at our expense and get your money back.

FREE. Our 40 page pamphlet giving full information and particulars concerning this valuable publication. You cannot afford to miss this opportunity.



CUT OFF HERE

GEO. A. ZELLER
ST. LOUIS, MO.

Enclosed please find $3.50 for which send me Spangenberg's Steam and Electrical Engineering, it being understood that if same is not satisfactory I may return it within 10 days and have my money refunded.

Name.....

Address.....

POPULAR MECHANICS, Dec.

GEO. A. ZELLER,

Established 1870. **19 S. 4th St., St. Louis, Mo.**

Please mention Popular Mechanics when writing advertisers.

FREE *This Fine Hollow Ground Hand Finished Razor Will for a Limited Time, be Given Free to Every Purchaser of the* Radiumite Dollar Razor Strop

Send 10c extra for postage, etc.

We make this remarkable free offer of a most excellent razor, that sells at $2.00 at retail, to acquaint all with the marvelous and instantaneous honing and finishing properties of the **RADIUMITE STROPS** which will not harm the finest and most delicate razor. They make shaving a convenience and a delight, even to men having the hardest beards.

The secret of a quick, clean shave does not lie so much in a good razor as in a good strop. With the **RADIUMITE STROPS,** the most inferior razors are brought up to a fine edge, and the effect of the strops upon the finest razors is to keep them at all times in the best possible condition, ready to shave the hardest beards easily and delightfully. **Each Radiumite Strop is sold under the positive guarantee that if it is not satisfactory your dollar will be refunded. They are for either Ordinary or Safety Razors.** Most dealers handle the **RADIUMITE** products. Those who do not are rapidly taking them on. ***Radiumite Strops--50c to $2.50. Radiumite Razors--$1.00 to $3.00.*** Radiumite Catalog free to all.

THE STROP THAT HONES

When you buy, buy right—say Radiumite to your dealer.

We want good agents for introductory purposes—men with a large acquaintance among the business, office and factory men of their respective towns.

THE PETER L. FROST COMPANY
Dept. 15, 95-97-99-101 S. Clinton St., Chicago, U. S. A.

DEALERS, WRITE FOR TRADE DISCOUNTS!
CATALOGUE FREE

FREE HAIR FOOD

FALLING HAIR AND BALDNESS ABSOLUTELY CURED

There is but one way to tell the reason of baldness and falling hair, and that is by a microscopic examination of the hair itself. The particular disease with which your scalp is afflicted must be known before it can be intelligently treated. The use of dandruff cures and hair tonics, without knowing the specific cause of your disease, is like taking medicine without knowing what you are trying to cure. **Send a few fallen hairs** from your combings, to Prof. **J. H. Austin,** the celebrated Bacteriologist, who will send you **absolutely free** a diagnosis of your case, a booklet on care of the hair and scalp, and a sample box of the remedy which he will prepare specially for you. Enclose 2c postage and write to-day.

PROF. J. H. AUSTIN
178 McVicker's Theatre Bldg., Chicago.

You CAN WEAR OR GIVE A FINE DIAMOND

Don't buy a Christmas Diamond until you have received our catalogue and read the story of the

WONDERFUL ZAMBESA DIAMOND.

Looks and wears like a real diamond costing twenty times as much, and is being worn by thousands of the best people. **Only fine, solid gold mountings used.** We send them **On Approval.**

We pay all express charges—you do not pay a penny until you have seen and tested the article and decide to buy. **You are to be the sole judge.**

Our catalogue answers every question—write today for a copy. A postal card will fetch it.

With $5 you can make a Christmas gift worth while—one that will last forever. Signed guarantee of permanency sent with every Zambesa Diamond.

Boylston Diamond Co.
(Incorporated.)
700 Boylston Building
CHICAGO, ILL.

References:
A. W. JEFFERIS & CO.
Bankers, Chicago.

STEVENS

Uncle Sam says, "LEARN TO SHOOT STRAIGHT"

An American boy equipped with a STEVENS is a first rate combination. NOW is the time to go into the woods and enjoy shooting and the great "out-of doors." Our line:

RIFLES, PISTOLS, SHOTGUNS

for young and old of either sex.

All dealers handle the popular and efficient STEVENS ARMS.

Send 4 cents in stamps for new 136-page STEVENS Book describing all our products.

Our Rifle Puzzle is a winner, and lots of fun. FREE for the asking.

J. STEVENS ARMS & TOOL CO.,
40 Main Street, . . CHICOPEE FALLS, Mass., U. S. A.

RUBBER AS AN INVESTMENT

is sure to yield large returns. The owner of a bearing rubber orchard recently refused $1,250.00 per acre for it. Had you been in his place you would have done the same, for it is worth more.

WE ARE PLANTING RUBBER

which in a few years will be worth the price above quoted, but which you can now purchase for less than one-fifth that amount, per acre. Is not such an investment worth while?

Meanwhile your money is not idle, but earning a larger rate of interest than your savings account. We have just paid

DIVIDENDS OF 8 %

to our investors, earned from side crops. Besides rubber, we are planting and raising sugar-cane, cassava, oranges, hogs and cattle.

Our dividends will become larger annually until rubber comes into bearing, when they will amount to 50 per cent or over.

To plant the remainder of our 5,000 acres we are offering Plantation Certificates on terms within reach of all. The proposition is absolutely safe. It is being managed by men of experience and ability. Remember, we don't want your money until you are satisfied that our proposition is genuine. Don't fail to **WRITE NOW** for our illustrated literature. It costs you nothing.

PAN-AMERICAN PLANTERS CO., 153 LaSalle St., Chicago

Best Christmas Present $1 Will Buy

IS A YEAR'S SUBSCRIPTION
TO POPULAR MECHANICS

Cannot fail to please any man and will please him for twelve months

Fill in address and mail with One Dollar at our risk.

POPULAR MECHANICS, Journal Building, Chicago

Send your Magazine one year, commencing with the month of

..... to .....

Name ..... Street .....

City ..... State .....

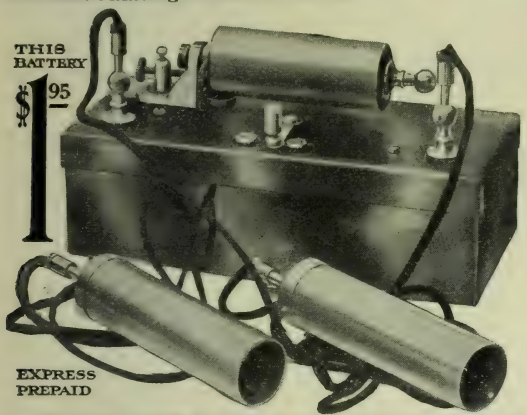
and notify party named above that the subscription has been paid for, and is sent with the compliments of .....

ELECTRICITY BOOK FREE

Profusely Illustrated With Photos From Life. Write For It To-day.

This splendid book is compiled from the best authorities in the world. Explains how electricity as supplied by inexpensive batteries cures **Rheumatism, Dyspepsia, Insomnia, Liver and Kidney Trouble** and all nerve affections and diseases due to poor circulation.

Explains how to enjoy the famous electric baths and **beauty and health massage** at home at little cost.



This book also lists the latest improved Batteries (Prices, $1.95 to $11.35) which we send prepaid, and allow **10 days free trial.**

DETROIT MEDICAL BATTERY CO.,
1239 Walker Block, Detroit, Mich.
Write to-day for our Free Book.

"Want" and "For Sale" Ads. 2 cents per word, payable in advance. Replies may be sent to a number, care Popular Mechanics, and will be forwarded promptly without extra charge.

"SHOP NOTES"—Cloth $1, paper covers 50 cents. Popular Mechanics.

ENGINES

BUILD YOUR OWN DYNAMO, Motor, Engine or Locomotive. We have the castings. We will take machinery or any other things that you wish to dispose of as part payment if same is in good condition. Send two stamps for circular and terms. Salineville Model & Machine Works, Salineville, O.

FOR SALE—Engines, gasoline. From one to eight h. p. All new. Simplest engine made and very cheap. John Fox & Co., Covington, Ky.

WESTINGHOUSE DYNAMO, 60-LIGHT—A bargain; send stamp for description and price. Drawer 5, Salineville, Ohio.

FOR SALE.

WON'T THIS JAR YOU—One No. 3 Caligraph typewriter in solid oak, 8-drawer desk case, $40; 4x5 Premo camera and a fine large outfit, $20; One new Harrington geared chain hoist ¼ ton with a good armature sling, $15; Lot magazines, mechanical journals, and papers, 2 and 4c per copy, all in good shape. Salineville Model & Machine Works, Salineville, O.

FOR SALE—Two gasoline launches one 33 ft., 7 ft. beam, 12 h. p. jump spark engine, with cabin. Will sell for $500 spot cash. The other a 24 ft. 7½ ft. beam, 6 h. p. Miamus gray engine, sell for $275, or both for $750. Write for further particulars to P. E. Vaninwigen, 52 Front St., Newburgh, N. Y.

FOR EXCHANGE—Fine 4x5 long focus camera and outfit; good as new; cost $65. Want Racine or Rushton boat or canoe. Ralph Currier, Rose Hill, Iowa.

NO USE FOR HOT BOXES—Threshermen and millmen, give us your names and postoffice addresses and we will send you samples of our lubricating oils and greases by mail, prepaid, with prices showing you a saving of from $3 to $7 per barrel on the highest fire test oils made. Independent Oil Co., Mansfield, Ohio.

FOR SALE—14K. gold hunting case, gent's size, very fine Swiss minute repeating watch; bargain at $110. Also one silver open-face inlaid with black enamel, fine Swiss movement; strikes quarter hours at $50. Will be sent to responsible parties by express, C. O. D. with privilege of examination. W. N. Emhaus, 22 Maiden Lane, New York. Established 30 years.

FOR SALE—The best car mover on earth. Good opening for agents as side line. Write us for circular, explaining the Badger Car Mover. Price $5 f. o. b. Appleton. Western Specialty Co., Appleton, Wis.

FOR SALE—Incandescent battery lamps from 1¾ to 220 volts and candle power from ⅛ to 100; 40c each and base 10c. Discount given on dozen lots. Smith Bros.' Electric Supply House, 363 W. Van Buren St., Chicago.

FOR SALE—Mechanical-Electrical scholarship (correspondence), Armour Institute of Technology, with 10 volumes reference library. Sold at $65, will take $45 cash, or $47.50 installments for books and course. B. Bean, 16 Wisconsin St., Chicago.

BUSINESS CHANCES.

WANTED—MECHANICAL PARTNER—I have been engaged for the past year in manufacturing a machine for which there is a very large and growing demand. The work is such that I desire the co-operation of some bright experienced mechanic to join me. Only a few hundred dollars required; 200 per cent profit in the business. Address, 768, care Popular Mechanics.

WANTED—Painters to learn sign painting by our new method of cut cardboard letter patterns. Send stamp for circulars and samples. E. T. Littlefield, Adams, N. Y.

YOU GET SOMETHING of everlasting benefit when you order our business penmanship course. Best published. Used in many schools. Complete set of lessons for home practice, 50 cts.; with personal mail instruction, $1.00. Order now; stamps taken. Rasmussen School of Penmanship, Globe Bldg., St. Paul, Minn.

FOR SALE—Write for price on the only foundry, machine shop and boiler shop in Black Hills. J. C. O'Donnell, Deadwood, S. D.

FOR SALE—A specialty which pays manufacturer 100 per cent profit; can be made in almost any shop; patent has 14 years to run; will sell patent, dies, and a good trade already established. Owner is located on Pacific coast and does not wish to change residence. Address 769, care Popular Mechanics.

FOR SALE—Blacksmith shop with contents, warehouse, wood and paint house, dwelling house, two barns and stable, and other out-houses; will sell cheap. Address A. Egg, Cistern, Fayette Co., Texas.

FOR SALE—At less than half price, the entire outfit of machinery of a 25-barrel flouring mill—rolls and burrs. Address J. M. Whetstone, Box 394, Winterset, Iowa.

BUSINESS CHANCES—CONTINUED.

FOR SALE—FOR ONE DOLLAR—Sir and Brother Smith: I have been a factory steel worker forty years, and these are best methods used by expert smiths I have met. The New Treatise on New Steels explains all the new steels and tells how to work them successfully. Also seventy-five new methods of forging and welding on machine and plow work, making all difficult jobs easy, with ten receipts for making your own welding compounds for welding the different kinds of steel solid and no time wasted. You can make money making and selling to blacksmiths some of these compounds. Thermite welding fully explained; it welds railroad rails in the twinkle of an eye; this is very valuable to understand Also two hand-colored Tool Tempering charts. Chart A explains all annealing and hardening. Chart B explains both scientific and plain tempering to a standard in oil, water or tallow, showing true color each tool should be and telling what it will stand. All the above for One Dollar, and any one buying these and not satisfied I will return his money free. Yours respectfully, W. M. Toy, Sidney, Ohio. Samples free.

FOR SALE—Wagon shop, building, land and machinery in a hustling town in central Wisconsin. Reason for selling, poor health. G. I. Thew, Lock Box No. 633, Mauston, Wis.

AUTOMOBILES.

FOR SALE—One 10 horse power Ford with tonneau practically new; one 8 horse power with top and one St. Louis runabout in good shape and new tires. H. K. Wilson, New Bedford, Mass.

FOR SALE—1903 Oldsmobile. Artillery wheels, with top; two extra inside tubes, new. Machine in good condition; $300 takes it. Dr. Binnie, Almena, Kan.

FOR SALE—Gasoline runabout, on time or will trade for diamond or typewriter. Box 911, Shenandoah, Iowa.

$185 will buy my 4 h. p. gasoline automobile. It is in good running order. Dr. Hoffman, Plainfield, Ill.

FOR SALE—One 10 h. p. Ford, practically new, with tonneau; one 8 h. p. with top, in A-1 shape, and one St. Louis runabout, in good shape and new tires. H. K. Wilson, New Bedford, Mass.

FOR SALE—Wood mud guards and seats for repairs of all cars. American Veneer Co., 122 Market St., New Orange, N. J.

SEND FOR LIST of S. H. engines and auto supplies. W. Hoffman Motor Works, 1251 N. Halsted St., Chicago, Ill.

WANTED.

WANTED—Young men to learn Telegraphy and R. R. Accounting. Our graduates receive from $50 to $150 per month. Endorsed by all railroads. Write for catalogue. Morse School of Telegraphy, Cincinnati, O., Elmira, N. Y., La Crosse, Wis., Atlanta, Ga.

WANTED—Direct-current arc lamp, 110 volts; cheap for cash. Box 784, Cripple Creek, Colo.

POSITION WANTED—By inexperienced young man to learn the automobile business in some factory or garage. Can furnish best of reference. Address John H. Evans, West Goshen, Litchfield Co., Conn.

HELP WANTED.

ONE MECHANIC in every shop to earn good money. Address 'Money," care Popular Mechanics.

WANTED—Men to learn barber trade; splendid demand for our graduates; few weeks completes by our method; can nearly earn expenses before completing; diplomas granted, positions guaranteed. Write nearest branch. Moler System of Colleges, Chicago, Ill., St. Louis, Mo., New Orleans, La., Cincinnati, Ohio, Omaha, Neb., or New York City.

PATENTS

PATENTS SECURED through Popular Mechanics Patent Bureau promptly. Charges reasonable. If you have a new idea or invention write us regarding it. We will answer promptly and fully without charge. Address Popular Mechanics Patent Bureau.

PATENT YOUR INVENTIONS—Washington attorneys give best service; terms reasonable; advice free. Bevans & Co., Colorado Building. Washington, D. C.

MISCELLANEOUS.

CASH, OR WILL EXCHANGE for kodak or guns, complete lessons "Metal Mining," International Correspondence Schools; cost $65. Lessons on "Cyanide Process;" cost $15. Blow pipe outfit; cost $15. Complete drawing outfit; cost $10. Address "Mining Engineer," care Popular Mechanics.

BRAINS FOR SALE—Do you want a prospectus written and illustrated for your new company or syndicate? Do you want one that will command attention and sell shares? Do you need a catalogue or booklet that will not be thrown in the waste basket? If so write to Expert, care of Popular Machanics, Journal building, Chicago.

WHEN YOU WANT anything and don't know where to get it, write Popular Mechanics.

THE FRACTOMETER will instantly solve all problems in addition or subtraction of fractions and their decimal equivalents. Every person has need for this wonderful invention, especially Draftsmen, Engineers and Mechanics. Price 50c postpaid, or given free with a year's subscription to Popular Mechanics at $1 per year. Popular Mechanics, Journal Bldg., Chicago, Ill.

DEATH is said to be pleasant when it takes place by drowning; however, we do not believe you want to die that way. "How to Swim" is the book that will teach you how to swim. Contains 100 illustrations; sent postpaid for $1. Popular Mechanics.

BINDERS—Will hold Popular Mechanics 12 issues. Sent postpaid on receipt of 50 cents. Address Popular Mechanics.

IF YOU WISH to buy anything or have something manufactured and don't know where to get it, write Popular Mechanics, Journal Bldg., Chicago.

GAS BALLOONS bought, sold, made; any size. Carl E. Myers, Supt. Aeronautical Dept., St. Louis, Mo., Exposition. Address, with stamp, Balloon Farm, Frankfort, N. Y.

WE MAKE YOU A "POPULAR MECHANIC"—In mirror making, portrait painting, decalcomania, glass etching, embossing, chipping, transferring, and many other money-making methods. We instruct you thoroughly and we guarantee you success. 32-page prospectus and large list of students for your reference for stamp. There's money in it. Hullinger's Art School, Drawer 4, Francesville, Ind.

Five years subscription for three dollars. Popular Mechanics Co. make this offer. A great many people are taking advantage of it. It's open to you also.

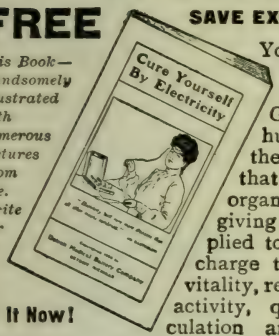
FARM PROPERTY.

FOR SALE—Illinois farm; 323 acres; black rich bottom land; clay subsoil; all can be plowed; no better corn land in the state; good buildings; fenced and crossed with Page woven wire; rural free delivery; long distance telephone; good gravel roads to city of 2,500 population. Home market for all farm products. Borden's Condensed Milk Factory. The price paid for milk for past six months, $4.50 per 100 lbs. Good school and creamery one-half mile from farm—6 miles northwest of Chicago. If sold quick will take $80 per acre. Part cash. Address, 766 Popular Mechanics.

"CURE YOURSELF BY ELECTRICITY"

FREE **SAVE EXPENSE—KEEP WELL**

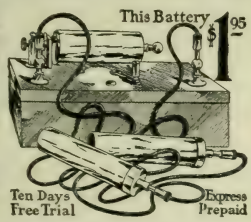
This Book—Handsomely illustrated with numerous pictures from life. Write for it.



You should have this book—It's free—Sent to all who write. Gives a diagram of the human body, showing the great nerve centers that controls the vital organs. Tells why the life-giving electric current applied to certain centers will charge the nerves with new vitality, restore organs to normal activity, quicken sluggish circulation and develop muscle; quickly curing **Rheumatism, Neuralgia, Lumbago, Headache, Insomnia, Constipation** and all **Nerve Affections** and diseases arising from **poor circulation.**

Do It Now!

This book shows how you can do it yourself at home with one of our New Home Batteries (price $1.95 to $11.35) and their various attachments. It also shows how they afford the celebrated Electric Baths and Beauty Massage without extra cost.



We send our batteries **Express Prepaid,** without a cent in advance, and allow **Ten Days Free Trial.** Write today for our Free Book.

DETROIT MEDICAL BATTERY COMPANY
1139 Walker Block, Detroit, Mich.

Common Red Clover

Cures Cancer, Eczema, Salt-Rheum, Rheumatism and all other Blood Diseases

How many people realize the true value of our common red clover? It is the best blood purifier known. Thousands of prominent people have been cured of cancer, rheumatism, constipation, eczema, skin and blood diseases by its use. Send your address to D. Needham's Sons, 116c Lakeside Bldg., Chicago, Ill., and they will mail free a full description of Red Clover Blossom Extract, a history of how Mr. Needham cured his cancer and testimonials from many who have used the remedy. If you have any disorder of the blood look into the merits of Needham's Clover. It is the best blood purifier known.

RUPTURE

Our 24-page book free describes the greatest invention of the 20th Century, for the relief and cure of Rupture. Shows interesting photos from life and contains new and valuable information. Greatest trial offer ever made by any firm. You will be interested. Write today.

DENCE & MERY, 160 Mery Block, Toledo, O.

AGENTS WANTED Sell our $1.00 bottle of Sarsaparilla for 35c; best seller; 200 per cent. profit; write today for terms and territory.

F. R. GREENE, 116 Lake Street, Chicago

Smith—"Why is Brown carrying his arm in a sling?"

Jones—"O, his horse kicked him and broke it. He went out horseback riding the other day instead of taking his automobile, and when the horse balked he got off and twisted its tail, from force of habit, you know."

POPULAR MECHANICS
SHOP NOTES

∴ 128 PAGES ∴
204 ILLUSTRATIONS

\- - -

Easy Ways TO DO Hard Things

\- - -

Bound in Cloth - - $1.00
Paper Covers - - - - .50

SENT POSTPAID ON RECEIPT OF PRICE

POPULAR MECHANICS
Journal Building Chicago, Illinois

THREE OUT OF FIVE

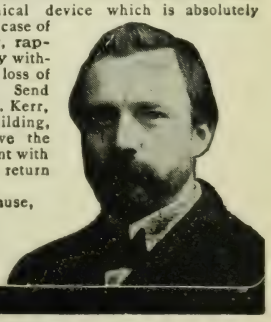
Men suffering from weakened nerve force, constant depression, gloomy forebodings, fast becoming unfitted for active business life, fail to attribute their deplorable state to the proper cause. They know they

HAVE VARICOCELE

as they have suffered much discomfort on account of it, particularly while standing. But the evil effects due to Varicocele are so gradual that they neglect it until the entire system is undermined and they are forced to realize that something must be done to prevent them from breaking down completely. To such sufferer I say, don't fall into the hands of Quacks—don't submit to the knife—don't pay enormous sums to so-called specialists—

Cure Yourself at Home

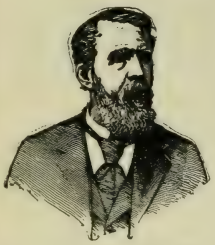
I have successfully treated and cured thousands of cases with a patent mechanical device which is absolutely guaranteed to cure any case of Varicocele painlessly, rapidly and permanently without inconvenience or loss of time from business. Send only **$2.00** to Mark M. Kerr, M. D., 706 Park Building, Cincinnati, and receive the full guaranteed treatment with simple instructions by return mail.



A treatise on the cause, effect and cure of Varicocele sent sealed FREE OF CHARGE.

STARRETT TOOLS

are the recognized standard for accuracy, workmanship, design and finish. Whether you use tools to earn your daily bread or for amusement and relaxation from a different vocation, it pays to use GOOD tools. You get a better quality of bread and a good deal more pleasure.



L. S. STARRETT

USE STARRETT TOOLS

We make hundreds of different tools. Ours is the largest plant in the world where nothing but fine mechanical tools are made. All these tools are fully described and illustrated in our Catalogue No. 17AP, which you may have by sending us your address. There is a good deal of valuable information in its 176 pages which it will pay anyone who uses tools to have.

THE L. S. STARRETT COMPANY
ATHOL, MASS., U. S. A.

An Investment Opportunity

WE OFFER THE BEST, STRONGEST AND SAFEST INVESTMENT PROPOSITION EVER OFFERED TO THE PUBLIC

We are in the most profitable business known, the raising of rubber and other tropical products and cattle in Mexico, and in a business that will earn and pay to investors in this company larger dividends than would be possible in any other business.

We own five thousand acres of the most fertile land in Mexico, with two miles frontage on the Trinidad River, navigable at all seasons, and with immediate railroad connections; gives us the best transportation facilities to the great home market as well as the markets of the world.

Our land is especially adapted for the raising of all tropical products and cattle. Live stock feed and fatten the entire year. Two crops of corn and beans annually. Cheap labor and a great home market at high prices for our entire production.

We offer a limited amount of stock upon an easy payment plan, which makes an opportunity for you to make an investment that will be safe and at the same time earn annually large dividends for yourself and family for life.

Write Today for our Booklet, "MARVELOUS MEXICO" and learn more about this Proposition

The Mexican Cattle & Plantation Co., Suite 1262 Monadnock Bldg., Chicago

Popular Mechanics Book Department

We can furnish any book published. Books in the following list sent prepaid on receipt of price, or for the number of New Yearly Subscribers stated. The Sender of the club may include his own subscription in clubs of three or more.

ARCHITECTURE BUILDING, PAINTING, ETC.

Steel Square, Treatise of the Practical Uses of, by Fred T. Hodgson, Architect. New and up-to-date. Published May 1st, 1903. Do not mistake this edition for the one published over twenty years ago. This is the latest practical work on the Steel Square and its uses published. It is thorough, accurate, clear and easily understood. Confounding terms and phrases have been religiously avoided where possible, and everything in the book has been made so plain that a boy twelve years of age, possessing ordinary intelligence, can understand it from beginning to end. Cloth, 2 volumes, 560 pages, 500 illustrations, price $2.00. Given for 3 subscriptions.

Hodgson's Modern Estimator and Contractor's Guide, for pricing all builders' work, with many tables, rules and useful memoranda, by Fred T. Hodgson. This work contains a concise explanation of the various methods of estimating builders' work by the square, by the cubic foot, by rough quantities, by accurate quantities and other methods. The mason, the plasterer, the bricklayer, the carpenter, the excavator, the plumber and, in fact, the representative of every trade that has anything to do with building will find rules and methods given in this volume for estimating the cost of work he is tendering for. Cloth binding, 300 pages, 200 illustrations, price $1.50. Given for 3 subscriptions.

Modern Carpentry and Joinery, a practical manual for carpenters and woodworkers generally, by Fred T. Hodgson, Architect. A new, complete guide, containing hundreds of quick methods for performing work in carpentry, joining and general woodwork. Like all of Mr. Hodgson's works, it is written in a simple, every-day style, and does not bewilder the working-man with long mathematical formulas or abstract theories. The illustrations, of which there are many, are explanatory, so that any one who can read plain English will be able to understand them easily and to follow the work in hand without difficulty. Cloth binding, 256 pages, 230 illustrations, price $1.00. Given for 2 subscriptions.

Hodgson's New Hardwood Finishing, by Fred T. Hodgson. A practical treatise on wood finishing in all its branches, including tools and materials employed, preparation of surfaces, stains and staining, fillers and filling, shellacking, varnishes and varnishing, rubbing, polishing, French polishing, wax polishing, oil polishing, etc., etc. Also a full description of the woods employed in wood finishing, their treatment, and the finishing of floors. Cloth, 320 pages, 100 illustrations, price $1.00. Given for 2 subscriptions.

Radford's American Ideal Homes, containing 100 house plans, 200 illustrations, 250 pages, cloth, price $1.00. Given for 2 subscriptions.

American Ideal Homes, edited by Radford, illustrating 100 buildings with plans and perspective views, size 8 by 11, 108 pages, price $1.00. Given for 2 subscriptions.

Burnham's Practical House Builder, with plans and specifications, by H. E. Burnham, 100 illustrations, paper cover, price 25 cents; cloth cover, price 50 cents. Given for 1 subscription.

Estimating Frame and Brick Houses, by Fred T. Hodgson, 224 pages, with scale drawings and other illustrations, price $1.00. Given for 2 subscriptions.

Barn Plans and Out Buildings, for the construction of barns, etc., 256 illustrations, cloth, price $1.00. Given for 2 subscriptions.

Common Sense Stair Building and Handrailing, by Fred T. Hodgson, M. O. A. A. Handrailing—Showing three of the smallest methods known in the art, with complete instructions for laying out and working handrails suitable for any kind of stairs. Stair Building—Section four of the work, which covers upwards of 80 pages, is devoted to newel or platform stairs chiefly, and gives instructions for their building, planning and decoration. Cloth, 256 pages, 230 illustrations, price $1.00. Given for 2 subscriptions.

Builders' Architectural Drawing Self-Taught, by Fred T. Hodgson. This work is especially designed for carpenters and architects and other wood workers who desire to learn drawing at home, and who have not the means, time or opportunity for taking a regular course in school or college, or availing themselves of the offers made by one or other of the "Correspondence Schools." This valuable work contains over 300 pages printed from new large type on a superior quality of cream wove paper. Over 300 fine line engravings made especially for the work, each drawn to scale, 18 large double folding plates with full explanation for each. Also contains perspective views and floor plans of 50 low and medium priced houses. Cloth, price $2.00. Given for 3 subscriptions.

Hodgson's Low Cost American Homes, arranged and edited by Fred T. Hodgson, M. O. A. A. This book contains perspective views and floor plans of one hundred houses, churches, schoolhouses and barns, and is, without a doubt, the most practical work ever issued. The plans shown have been built from, and many of them duplicated many times over. All are practical, the creation of the well-known author, including many other architects throughout the United States and Canada. Cloth, 220 pages, 200 illustrations, price $1.00. Given for 2 subscriptions.

PAINTS AND PAINTING.

The Painters' Encyclopedia, containing definitions of all important words in the art of plain and artistic painting, with details of practice in coach, carriage, railway car, house, sign and ornamental painting, including graining, marbling, staining, varnishing, polishing, lettering, stenciling, gilding, bronzing, and valuable hints and helps in scene painting, porcelain painting, plain painting, distemper painting, and all work in which a brush, pencil or palette is used, by Franklin B. Gardner. Cloth, 426 pages, fully illustrated, price $1.50. Given for 2 subscriptions.

Practical Carriage and Wagon Painting, a treatise on the painting of carriages, wagons and sleighs, embracing full and explicit directions for executing all kinds of work, including painting factory work, lettering, scrolling, ornamenting, varnishing, etc., by M. C. Hillick. Cloth, 160 pages, fully illustrated, price $1.00. Given for 2 subscriptions.

The Signist, new, original, up-to-date. These designs have been prepared especially for this book by a master in each special line, all of which are replete with helpful suggestions of new and practical ideas, which the skilled mechanic or the beginner may amplify to almost an unlimited extent. In the preparation of this book no expense has been spared to produce a standard text-book of original art gems which shall adequately supply a long-felt want. Paper cover, price $1.50. Given for 3 subscriptions.

ENGINEERING.

The 20th Century Hand Book for Steam Engineers and Electricians, with questions and answers, by C. E. Swingle, M. E. This is the very latest and best book on engineering and electricity for the beginner, practical engineer or electrician published. It is written in a purely self-educational style, so that any one with but a limited education can understand it. Illustrated with hundreds of fine engravings, showing every working part of an engine or boiler, dynamo, etc., 600 pages, size 5x7, durably bound in full leather, pocket book style, red edges, price $2.50. Given for 4 subscriptions.

Farm Engines and How to Run Them—The Young Engineer's Guide, by James H. Stephenson and other expert engineers, fully illustrated with about seventy-five beautiful woodcuts, a complete instructor for the operator or amateur. This book was the only one out of several that was accepted by 17 state agricultural colleges as a text-book for use of students in farm machinery. 12mo, cloth, 224 pages, price $1.00. Given for 2 subscriptions.

Modern Air Brake Practice, Its Use and Abuse, by Frank H. Dukesmith. The new air-brake book. Invaluable to trainmen, engineers, firemen, conductors, electric motormen and mechanics. The latest and best 1904 edition. With questions and answers for locomotive engineers and electric motormen. While there have been many air-brake books written, we feel safe in saying that never before has the subject been treated in the same lucid, understandable manner in which our author has treated it in this new book. The book is fully indexed and cross-indexed, so that any subject can be turned to immediately, as desired. If you are already posted, you can become better posted. If you really want to know all that is worth knowing about air-brake practice send for this book. 12mo, cloth, 303 pages, hundreds of illustrations, price $1.50. Given for 3 subscriptions.

The Locomotive Up-to-Date. The greatest accumulation of new and practical matter ever published treating upon the construction and management of modern locomotives, both simple and compound, by Chas. McShane. Cloth, 736 pages, 380 illustrations, price $2.50. Given for 6 subscriptions.

The Practical Gas Engineer, by E. W. Longanecker, M. D. A manual of practical gas and gasoline engine knowledge, covering errors to be avoided in the construction of, and how to correct, operate and care for gas and gasoline engines. Every user of a gas engine needs this book. Simple, instructive and right up-to-date. Full of general information about the new and popular motive power, its economy and ease of management. 16mo, cloth, 150 pages, fully illustrated, price $1.00. Given for 2 subscriptions.

ELECTRICITY.

Modern Wiring Diagrams and Descriptions—New 1904 Edition, a handbook of practical diagrams and information for electrical workers, by Henry C. Horstmann and Victor H. Tousley, expert electricians. This grand little volume not only tells you how to do it, but it shows you. It shows you how to wire for call and alarm bells, for burglar and fire alarm; how to run bells from dynamo current; how to install and manage batteries; how to test batteries; how to test circuits; how to wire for annunciators, for telegraph and gas lighting; it tells how to locate "trouble" and "ring out" circuits; it tells about meters and transformers; it contains 30 diagrams of electric lighting circuits alone; it explains dynamos and motors, alternating and direct current; it gives ten diagrams of ground detectors alone; it gives "compensator" and storage battery installation; it gives simple and explicit explanation of the "Wheatstone" Bridge and its uses, as well as voltmeter and other testing; it gives a new and simple wiring table covering all voltages and all losses or distances. 16mo, 160 pages, 200 illustrations, full leather binding, round corners, red edges, size 4x6, pocket edition, price $1.50. Given for 3 subscriptions.

Electricity Made Simple, by Clark Caryl Haskins. Just the book for beginners and electrical workers whose opportunities for gaining information on the branches of electricity have been limited. A book devoid of technicalities. Simple, plain and understandable. There are many elementary books about electricity upon the market, but this is the first one presenting the matter in such shape that the layman may understand it and, at the same time, not written in a childish manner. For engineers, dynamo men, firemen, linemen, wiremen and learners. For study or reference. Cloth, 233 pages, 108 illustrations, price $1.00. Given for 2 subscriptions.

Dynamo Tending for Engineers, or, Electricity for Steam Engineers, by Henry C. Horstmann and Victor H. Tousley. It is with a view to assisting engineers and others to obtain such knowledge as will enable them to intelligently manage such electrical apparatus as will ordinarily come under their control that this book has been written. The authors have had the co-operation of the best authorities, each in his chosen field, and the information given is just such as a steam engineer should know. 12mo, cloth, 208 pages, 100 illustrations, price net $1.50. Given for 3 subscriptions.

Modern Electricity, by Henry and Hora. Not only the latest but one of the most elaborate and complete works on this subject. Includes latest achievements of scientific research, with explanation of modern inventions and appliances; 150 illustrations, two special wiring diagrams, free from technical phrases, cloth, price $1.00. Given for 2 subscriptions.

Easy Electrical Experiments and How to Make Them, by L. P. Dickinson. The book is an elementary handbook of lessons, experiments and inventions. It is a handbook for beginners, though it includes, as well, examples for the advanced students. Illustrated with hundreds of fine drawings; printed on a superior quality of paper. 12mo, cloth, 216 pages, 120 illustrations, price $1.00. Given for 2 subscriptions.

Practical Compend of Electricity (Vest Pocket Size). Electricity in all its branches and applications described in concise and practical manner. Includes directions for wiring and lighting of houses, estimates of cost, etc. 119 illustrations, vocabulary of common technical terms, leather, gilt lettering, price 50 cents. Given for 1 subscription.

The Motorman's Guide, by J. W. Gayetty. An invaluable instructor, illustrated. Full instructions about the care and running of cars. The latest and best published. Cloth, price 50 cents. Given for 1 subscription.

Practical Telephone Handbook and Guide to Telephonic Exchange, How to Construct and Maintain Telephone Lines, by T. S. Baldwin, M. A., illustrated. Containing chapters on The Use of the Telephone, Series and Bridging Phones, Line Construction, Materials to be Used, Locating and Correction of Faults in Instruments and Lines. This is the best book ever published on farm telephones. It is the only book ever issued which treats the subject exhaustively and comprehensively. It is of inestimable value to promoters of rural party lines, because it contains all of the arguments that are necessary to show the advantage of rural party lines. It also tells how such lines should be constructed and cared for. Cloth, 180 pages, fully illustrated, price $1.25. Given for 3 subscriptions.

Telegraphy Self-Taught, a complete manual of instruction, by Theodore A. Edison, M. A., instructor at American School of Telegraphy, illustrated. In this valuable volume will be found everything that is necessary to the study of telegraphy. Though telegraphy is essentially a matter of practice, it has been the aim of the author to present to those who aspire to master the art of telegraphy a book treating the subject in as concise and clear a manner as possible, without eliminating anything that is important, and without putting in things that are detrimental, and which would have a tendency to confuse. Cloth, 160 pages, fully illustrated, price $1.00. Given for 2 subscriptions.

The Handy Vest Pocket Electrical Dictionary, by Wm. L. Weber, M. E. Contains upward of 4,800 words, terms and phrases employed in the electrical profession, with their definitions given in the most concise, lucid and comprehensive manner. The book is of a convenient size for carrying in the vest pocket, being only 2⅝ inches by 5½ inches, and ¼ inch thick, 224 pages, illustrated, and bound in two different styles. Cloth, red edges, indexed, 25 cents; full leather, gold edges, indexed, 50 cents. Given for 1 subscription.

Modern Electro-Plating, by J. H. Van Horne. The only work on the market that gives proper attention to the modern tools, materials and methods used in preparing work for plating. It takes up matters from the beginning and tells how to manipulate articles from the rough casting, forging or stamping, clear through all the processes of polishing, plating, etc., down to the final coat of lacquer. 189 pages, with 27 illustrations, handsomely bound in cloth, with full and complete index, price $1.00. Given for 2 subscriptions.

MECHANICS.

Modern Blacksmithing, Rational Horseshoeing and Wagon Making, by J. G. Holmstrom. This valuable work is written by a man having thirty years' practical experience. Elementary rules are employed, thus avoiding the more technical terms, rendering this treatise practical and more invaluable to all who have use for it. Even the oldest blacksmith or wagon maker will find many helpful suggestions, and any young man can master the principles of these two useful arts by a careful study of this book. The rules and recipes will be found of great value to farmers, horseshoers, wagon makers, machinists, liverymen, well drillers, manufacturers, as well as amateurs and young men on the farm. Over 200 pages, fully illustrated, price, cloth, $1.00. Given for 2 subscriptions.

Hot Water Heating, Steam and Gas Fitting, Acetylene Gas—How Generated and How Used, by J. J. Lawler and Geo. T. Hanchett. For plumbers, steam fitters, architects, builders, apprentices and householders; containing all modern methods and practical information of all the principles involved in the construction of steam, hot water, acetylene gas plants, and how to properly do gasfitting. Cloth, 334 pages, fully illustrated, price $2.00. Given for 4 subscriptions.

American Sanitary Plumbing, by J. J. Lawler. For plumbers, steam fitters, architects, builders, apprentices and householders. Containing practical information of all the principles involved in the mechanics and science of modern plumbing, illustrating, with original sketches, the fundamental principles of everything the plumber should know. Cloth, 320 pages, fully illustrated, price $2.00. Given for 4 subscriptions.

Dynamo and Motor Bargains

We carry in stock over 600 machines in all sizes from ⅛ to 100 horse power, both new and second hand, *all guaranteed*. Small factory equipments our specialty.

NO ONE

Can sell you a first-class machine for less money. We repair all makes. Send us your inquiries.

Guarantee Electric Co.

CHAS. E. GREGORY, Pres.

153 to 159 S. Clinton St.,

CHICAGO

Are You Dissatisfied?

Every man who has ambition is dissatisfied; not necessarily disgruntled or discouraged, or a malcontent, but dissatisfied *because he wants to go higher*. This is the right kind of dissatisfaction—it is the sign of a man who will make progress.

It is the mission of the International Correspondence Schools to help the man who is dissatisfied—the man who wants to better himself.

Thousands of ambitious men and women, aided by the I. C. S. system of training by mail, have been able to advance in place and salary. Many have been able to change their occupation, taking positions in their chosen profession.

The I. C. S. system of training by mail teaches mechanics the theory of their trades; helps misplaced people to qualify for more congenial work; and enables young people to commence work at better salaries than if they started without training.

We can train you, in your spare time, for a position as Civil, Mechanical, or Electrical Engineer; Architect; Surveyor; Bookkeeper; Stenographer; Ad Writer, or qualify you for Civil Service Examinations. We also teach French, German, and Spanish by the I. C. S. phonograph method.

Write, stating which subject interests you.

International Correspondence Schools

Box 872, Scranton, Pa.

Dear Sir:—Would you be open for an investment which will yield, with reasonable assurance, from 50 per cent to 100 per cent each year?

It will average 75 per cent—which means 6¼ per cent a month.

When I say investment, please understand that I do not mean a gambling proposition, such as stocks and grain speculation, or horse-race betting, nor anything which requires you to buy what you do not want, or sell what you have not got.

I REFER TO A STRAIGHT INDUSTRIAL PROPOSITION, which has for its commodity products produced by nature, and in turn manufactured into commercial necessities, for which the demand always exceeds the supply.

As a representative business man, I fully realize the annoyance of receiving unsolicited literature and advertising matter of unknown propositions.

Therefore, before placing before you, in full detail, the venture I refer to, I ask your consent, and for that purpose I attach this coupon, which explains itself. If agreeable, and you are open for a proposition which will produce all that I claim, kindly sign and mail it.

THIS COSTS YOU NOTHING BUT THE POSTAGE, AND PUTS YOU UNDER NO OBLIGATION.

In closing, permit me to say, that the men at the head of the corporation which I represent are men of great wealth and undisputed commercial integrity.

There is not a single questionable feature in the entire plan.

May I hope to hear from you by return mail?

Very sincerely,

L. C. WELTON, 59 Clark St., Chicago.

COUPON

Dear Sir:—You may send to my address full details of the proposition you refer to. I will carefully consider the matter, and, if interested, will write you further. This with the distinct understanding that I am under no obligations.

Name ..... Postoffice .....

County ..... Street and No. .....

Date .....1904. State.....

Patents

If you have a new idea or invention ask us what you want to know and we will answer promptly and fully without charge.

Patents Secured Promptly in the U.S. and All Countries in the World

WE *Secure patents of the broadest possible claims.*
Make research in the patent offices of all countries.
Prosecute infringements in the courts.
Find buyers for patents secured through us.
Protect and promote in every possible way the interests of our clients.

No Advance Charges for Information and Advice

All inventors should lose no time in taking steps to protect their inventions and especially in filing their applications for patents. Under recent decisions of the Commissioner of Patents and the courts preference is given to the diligent inventor where there is a question as to who made the invention first. By diligent inventor is meant the one who first perfects his invention in practical form and applies for a patent.

Important Decision

Many inventors lose the fruits of their inventive abitity through a disposition to procrastinate. If you feel that your invention is not as perfect as it might be, if you will write to us and tell us your troubles we will be glad to place at your disposal our mechanical experts who will assist you in completing or perfecting your machine or device.

Our Patent Attorneys and Consulting Experts are all practical men of large experience

CHARGES REASONABLE

Branch Offices: Washington, London, Berlin, Paris

AND ALL OTHER LARGE CITIES

Address

POPULAR MECHANICS PATENT BUREAU

Journal Building, Chicago

UNIVERSITY OF ILLINOIS-URBANA
3 0112 037604870